GLOBALISING EDUCATION: STRATEGIES, CHALLENGES, AND SUSTAINABILITY

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FOREWORD

Humanity stands at a pivotal moment in its collective history, where diverse global interests increasingly converge in the pursuit of peaceful coexistence. The affairs of nations and societies have become profoundly interconnected, with relationships expanding to such an extent that no nation can thrive in isolation, while collective consciousness is increasingly shared across borders. Globalisation, therefore, signifies not merely growing interconnectedness but also the emergence of complex supranational interactions and interdependencies that shape virtually every sphere of human endeavour.

At the heart of this global phenomenon, which is fundamentally aimed at advancing human development, lies the globalisation of the structures, practices, systems, and strategies of higher education, driven in large measure by the aspirations of the United Nations Sustainable Development Goals (SDGs). As globalisation continues to redefine institutions and practices across sectors, universities and other higher educational institutions are no longer constrained by geographical boundaries. Rather, they now operate within a global knowledge ecosystem in which collaboration and competition coexist, embedding international and intercultural dimensions into the core functions of teaching, research, innovation, and community engagement.

Consequently, institutions of higher learning across the world are increasingly challenged to produce graduates who are not only academically accomplished but also globally conscious, culturally responsive, technologically proficient, and equipped to address complex societal challenges that transcend national borders. The contemporary landscape of higher education is thus characterised by a dynamic interplay between global forces and local realities. While the globalisation of education has created unprecedented opportunities for international collaboration, cross-border mobility of students and scholars, accelerated knowledge exchange, and innovation in teaching, learning, and research, it has simultaneously raised critical questions concerning equity,

cultural identity, quality assurance, digital inclusion, policy harmonisation, funding, and institutional resilience.

This suggests that universities seeking to remain relevant and competitive within the global knowledge economy must pursue internationalisation with strategic intentionality. While striving to expand opportunities for knowledge exchange and strengthen their competitive advantage, they must equally ensure that their internationalisation agenda aligns with the broader imperative of sustainable development. Such alignment is essential because the evolving global context within which higher education now operates is characterised by the intersection of market competitiveness and sustainability. Accordingly, the pursuit of globalisation and sustainability in higher education should not become merely a positional exercise in which institutions perform sustainability primarily to enhance rankings and institutional reputation, rather than to contribute meaningfully to the global commons. Instead, higher education institutions must endeavour to balance global competitiveness with local relevance, ensuring that education remains a public good dedicated to human development and societal progress.

The University of Ilorin has consistently positioned itself for this imperative, and as a forward-looking institution committed to excellence in teaching, research, innovation, community engagement and ethical leadership. Our vision extends beyond national relevance towards meaningful participation in the global knowledge ecosystem. Through strategic partnerships with universities, research institutions, development organisations, and international agencies across the world, the University continues to strengthen its international profile while remaining firmly committed to addressing local and national developmental priorities.

The establishment of the Centre for International Education, recently renamed the Centre for Internationalisation and Strategic Partnership, clearly demonstrates this commitment. The Centre has continued to serve as a catalyst

for internationalisation by promoting global academic partnerships, facilitating staff and student exchanges, encouraging collaborative research, and fostering intercultural understanding.

With its longstanding engagement in the discourse, practice, and scholarship of the globalisation of higher education, the University of Ilorin recognises the complexities that characterise the evolving phenomenon of internalisation of education. It is against this backdrop that the Centre for Internationalisation and Strategic Partnership brought together distinguished academics, researchers, policy experts, and practitioners from diverse disciplinary and geographical backgrounds during its first international conference to deliberate on the opportunities and challenges associated with globalising education. Through rigorous discussions and scholarly engagement, participants, during the conference, offered rich theoretical insights, empirical evidence, and practical perspectives on strategies for advancing global education while addressing its inherent challenges. This publication is the outcome of that remarkable intellectual engagement at the International Conference on *Globalisation of Education: Strategies, Challenges and Sustainability*.

The international conference, and its enduring legacy in this edited book, further demonstrates the unwavering commitment of the University of Ilorin to advancing knowledge, promoting international collaboration, and contributing meaningfully to contemporary educational discourse. It also reflects our commitment to sustainable development through the pursuit of education, not as an end in itself, but as a powerful instrument for societal transformation. The diversity of perspectives represented in the chapters of this edited book not only reflects considerable scholarly depth but also underscores the inherently interdisciplinary nature of contemporary educational issues. Collectively, these contributions demonstrate the indispensable role of collaborative scholarship in generating sustainable

solutions to global educational challenges. Indeed, each chapter offers a distinctive perspective through which readers may appreciate the varied dimensions, strategies, and complexities associated with the globalisation of education.

Among the diverse themes explored are the imperative of digital technologies in the internationalisation of education, digital equity and sustainable global learning, digital sustainability in global education, cross-border digital education, and equitable access to education within the global landscape. The book also presents rigorous empirical analyses of curriculum internationalisation for equitable global impact, international partnerships and collaborations, bridging global approaches with local realities, enhancing trust and transparency in virtual teams, the glocalisation of Africa's untapped heritage, globalising reformation education programmes within correctional facilities, global university networks, online learning and carbon footprints, the internationalisation of higher education in South Africa, and many other contemporary issues of significant scholarly and practical relevance.

It is particularly gratifying that the contributors to this edited book have examined these issues with remarkable intellectual rigour and practical relevance. Their analyses illuminate the multifaceted dimensions of educational globalisation while proposing strategies that are adaptable across diverse institutional and national contexts. I am confident that policymakers, educational administrators, academics, researchers, postgraduate students, and development practitioners will find this book an invaluable resource for both scholarship and professional practice.

I warmly congratulate the editors, chapter contributors, reviewers, and the Centre for International Education and Strategic Partnership for producing this outstanding scholarly work. The collective efforts of all stakeholders, whose dedication made both the conference and this publication possible, exemplify the values of excellence, integrity, collaboration, and innovation that define

the University of Ilorin. Indeed, the successful organisation of the international conference from which this volume emerged further demonstrates the growing capacity of our Centre for International Education and Strategic Partnership to convene distinguished scholars and thought leaders in addressing issues of global significance.

As this book reaches readers across the world, I trust that it will stimulate informed reflection, deepen scholarly discourse, and inspire meaningful partnerships that strengthen educational systems globally while remaining responsive to local realities. It is my sincere hope that the ideas presented herein will influence policy, enrich professional practice, and contribute to building more inclusive, resilient, and sustainable educational futures for generations to come.

I therefore commend this book to scholars, policymakers, educators, development partners, and all who remain committed to the transformative power of education in an increasingly globalised world. May this publication stand as a lasting testament to the University of Ilorin's enduring commitment to academic excellence, global engagement, and sustainable development.

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A book is often likened to a garden, and an edited volume such as this is a garden cultivated by many hands. The successful completion of this book is a testament to the invaluable contributions of numerous individuals and organisations whose encouragement, commitment, and support nurtured this project from its conception to its fruition. Conceived as a legacy project during my tenure as the Director of the Centre for Internationalisation and Strategic Partnership, University of Ilorin, this volume stands as an enduring scholarly achievement, made possible through the collective efforts of contributors, reviewers, editors, institutional partners, and well-wishers.

Foremost among the supporters of this publication is the Joint Admissions and Matriculation Board (JAMB), which generously provided the sole financial support for the publication of this edited book. I therefore express my profound gratitude to the Registrar and Chief Executive of JAMB, Professor Isha'q Olarenwaju Oloyede, for his unwavering commitment to advancing scholarship and supporting initiatives that promote knowledge creation and dissemination.

I also wish to express my deep appreciation to the Vice-Chancellor of the University of Ilorin, Professor Wahab Olasupo Egbewole SAN, for his unwavering support, encouragement, and leadership, which greatly contributed to the successful organisation of the international conference from which this volume emerged. I am particularly grateful for his gracious acceptance of the invitation to write the Foreword to this book. His willingness to lend his voice and that of the institutional leadership he represents to this publication reflects his enduring commitment to promoting scholarship, internationalisation, and academic excellence at the University of Ilorin.

An edited volume of this nature is fundamentally a product of collaboration. This book reflects the intellectual contributions of distinguished scholars from different parts of the world whose research and insights have enriched the discourse on globalising education. I sincerely appreciate every contributor for

willingly sharing their expertise, rigorous scholarship, and valuable perspectives, all of which have significantly enhanced the quality and relevance of this publication. While the contributions of the chapter authors are deeply appreciated, the scholarly quality of this volume owes much to the meticulous work of the Editorial Board, comprising dedicated editors and reviewers. Ably led by Professor Adesina Lukuman Azeez (University of Ilorin), the Board comprised accomplished scholars and experts from the University of Ilorin and other institutions worldwide. Their rigorous review, constructive feedback, and unwavering commitment to academic excellence are clearly reflected in the quality of the chapters selected for publication. I am profoundly grateful to every member of the Board for their dedication and invaluable service to this project. To immortalise the invaluable service of our reviewers to the success of this book project, I am obliged to identify and list them one by one in these acknowledgments as follows: Dr. Raveesh Agarwal (Rajshree Institute of Management & Technology, India); Dr. Jumoke I. Oladele (University of Ilorin); Prof Yahaya Khadijat Adenola (University of Ilorin); Dr. Olubuni Atolani (University of Ilorin); Prof. Adeniran Jamiu Adetayo (University of Ilorin); Dr. Bilqis Owokunle-Lawal (University of Ilorin); Dr. Abdulhakeem Zubair (University of Ilorin); Dr. Peter Oloba (University of Johannesburg, South Africa); Dr. Bayo Isa (University of Ilorin); and Dr. Yusuff Ridwan. O. (University of Ilorin).

I must especially thank Professor Adesina Lukuman Azeez and Dr Jumoke Oladele, who were the fulcrum of the Editorial Board, and whose exceptional coordination of the book project was instrumental to its successful completion. Through their tireless communication with contributors, meticulous attention to detail, and efficient management of the editorial and production processes, they ensured the smooth implementation of every stage of the project. Their commitment and professionalism deserve special recognition for which I will ever be grateful.

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I further extend my sincere appreciation to all members of staff of the Centre for Internationalisation and Strategic Partnership for their unwavering support, particularly in the planning and successful organisation of the international conference from which this edited book emerged. Their administrative competence, commitment, and professionalism contributed immensely not only to the success of the conference but also to the coordination and processing of the chapters that constitute this publication.

Finally, I gratefully acknowledge all other individuals, institutions, and partners whose various contributions—whether great or small—helped to bring this project to a successful conclusion. Every act of support, encouragement, and collaboration has been invaluable. It is my earnest hope that this volume will make a meaningful contribution to the growing body of knowledge on globalising education and will continue to inspire scholarly inquiry, international collaboration, and the pursuit of excellence that remain the hallmark of the University of Ilorin.

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EDITORIAL COMMENT

It is with great pleasure that I present this collection of scholarly contributions arising from the International Conference on **"Globalising Education: Strategies, Challenges, and Sustainability,"** organised by the Centre for Internationalisation and Strategic Partnership, University of Ilorin, from 16–17 April 2025. The conference sub-themes have provided the intellectual foundation for the rich and diverse chapters that constitute this edited book.

The conference theme drew attention to the strategic, challenging, and sustainability dimensions of globalised education. Accordingly, the contributors to this volume critically explored such issues as curriculum internationalisation, technology-enhanced learning, cultural diversity and inclusion, global partnerships, quality assurance, and the broader social responsibilities of educational institutions. Consistent with the conference sub-themes, the chapters collectively examine how education continues to evolve within an increasingly interconnected world and how institutions, educators, researchers, and policymakers can respond to emerging global realities through innovation, collaboration, inclusion, and sustainable practice. Together, these contributions demonstrate that globalising education extends far beyond crossing geographical boundaries; it entails developing educational systems that are culturally responsive, equitable in access, innovative in practice, and sustainable in impact.

A defining strength of this volume is its sustained emphasis on cultural diversity, inclusion, and social justice. The chapters addressing counselling education, gender equity, special needs education, and inclusive learning environments underscore the imperative of preparing learners and professionals to thrive within culturally diverse societies. These contributions align closely with the conference's commitment to promoting diversity and inclusion within educational institutions by presenting practical approaches to equity, accessibility, and social responsibility.

The book also offers significant insights into technology-enhanced learning, a central pillar of contemporary educational globalisation. Several contributors examined digital education, multimedia learning, artificial intelligence, open educational resources, and cross-border digital learning ecosystems. Their analyses reveal both the transformative potential and the persistent challenges associated with educational technology, including digital inequalities, language barriers, infrastructure deficits, and issues of accessibility. Importantly, many of these studies move beyond technological optimism by advocating locally relevant, culturally responsive, and learner-centred approaches to digital innovation.

The chapters on culturally responsive artificial intelligence in education, curriculum internationalisation, global university networks, and cross-border education argue persuasively for educational models that transcend traditional boundaries while remaining firmly grounded in local realities. They demonstrate that meaningful internationalisation requires the integration of global perspectives, multilingual engagement, cultural responsiveness, and critical reflection on prevailing educational assumptions. These perspectives resonate strongly with the conference objective of examining global trends and the international dimensions of education.

Equally noteworthy is the book's attention to global partnerships and collaboration. The chapter examining the University of Ilorin's international partnership strategies provides compelling evidence of how institutional collaborations can strengthen research, enrich academic programmes, expand mobility opportunities, and facilitate knowledge exchange. Across the book, international cooperation emerges as a vital catalyst for educational transformation, capacity building, and sustainable development. Collectively, the contributions on partnerships and collaboration reaffirm the conference's position that collaborative networks remain indispensable for addressing the complex challenges confronting education in a globalised world.

The book further advances scholarly discussions on sustainability and social responsibility, another key sub-theme of the conference. Whether addressing digital education for sustainable development, environmental literacy through earth science education, agricultural extension, health promotion, correctional rehabilitation, or antimicrobial resistance education, the contributors consistently emphasised education's transformative role as a catalyst for social progress and long-term societal resilience. These chapters remind us that educational globalisation must ultimately contribute to the well-being of communities and the sustainability of our shared future.

Another commendable feature of this book is its strong commitment to evidence-based solutions. Many contributors who worked on the challenges of globalisation of education proposed practical and actionable recommendations for policymakers, educational leaders, practitioners, and researchers. Critical issues such as professional competence, digital access, inclusive education, ethical practice, curriculum reform, international collaboration, and quality enhancement are examined in this book through strategies capable of informing policy development and institutional transformation.

Taken together, the chapters in this book demonstrate that the future of education depends upon our collective ability to balance global engagement with local relevance, technological advancement with human-centred values, and innovation with sustainability. The scholarship presented herein makes a significant contribution to contemporary discourse on how education can effectively respond to global challenges while remaining inclusive, equitable, and transformative.

I sincerely commend the authors for their rigorous scholarship and invaluable contributions. Their work enriches the discourse on globalising education and provides important insights for academics, practitioners, institutional leaders, development partners, and policymakers alike. I also express my profound appreciation to the Editorial Board, ably led by Prof. Azeez Adesina

Lukuman, and to the team of reviewers for their unwavering commitment, meticulous evaluation, and dedication to ensuring that every chapter meets internationally recognised scholarly standards.

It is my sincere hope that this book will stimulate further scholarly inquiry, strengthen international academic engagement, and contribute meaningfully to the advancement of educational excellence, innovation, and sustainability, both within and beyond national boundaries.

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CHAPTER ONE

The Role of Digital Education in Advancing Sustainable Development Goals: A Study of the Rohilkhand Region, Uttar Pradesh

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Abstract

The objective of the research is to explore the role of digital education in achieving the Sustainable Development Goals (SDGs) in the Rohilkhand region of Uttar Pradesh, India. For this study, both primary and secondary data sources were utilised. Primary data were collected from 159 participants in the academic field, including educators, students, and administrative staff. The study revealed that digital education significantly contributes to advancing the SDGs, especially SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth), by improving accessibility, enhancing the quality and relevance of educational content, and promoting inclusive learning opportunities. Furthermore, digital platforms are shown to foster digital literacy, technological skills, and lifelong learning, which are essential for economic empowerment and sustainable development. The findings highlighted the transformative potential of digital education to address regional disparities and promote equitable growth, thereby contributing to a more sustainable and knowledge-driven society in the Rohilkhand region.

Keywords: Digital Education, Digital Literacy, Quality Education, Sustainable Development Goals (SDGs).

Introduction

Education has long stood at the heart of human development, not merely as a means to literacy but as a powerful catalyst for social mobility, economic growth, and global sustainability. In the contemporary context, the infusion of digital technologies into educational systems represents a transformative force, particularly in regions struggling with socio-economic disparities, infrastructural deficits, and limited access to quality instruction. The Rohilkhand region of Uttar Pradesh—an area marked by diverse

demographics, uneven development, and digital divides—offers a compelling landscape for studying the influence of digital education on the realisation of the Sustainable Development Goals (SDGs), especially SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth).

The United Nations' 2030 Agenda, adopted in 2015, firmly places education at the core of sustainable development. SDG 4 calls for inclusive and equitable quality education and lifelong learning opportunities for all. However, despite the clarity of this mandate, implementation has varied significantly across geographies. The advent of digital education—encompassing online learning platforms, mobile applications, virtual classrooms, and AI-driven educational tools—has been hailed as both a disruptor and a democratiser. According to Mishra and Koehler (2021), digital pedagogies can expand access, personalise instruction, and build future-ready skills, yet they also risk deepening pre-existing inequalities if not adapted sensitively to local contexts.

India's National Education Policy (NEP) 2020 explicitly recognises the role of digital infrastructure in bridging learning divides and improving educational outcomes. As Kumar, Jena, and Dey (2022) note, digital learning ecosystems have gained traction in Indian higher education, driven by both state-level reforms and market innovations. However, the success of these interventions, particularly in semi-urban and rural areas like Rohilkhand, depends on factors such as internet penetration, teacher readiness, socio-cultural acceptance, and policy support. The region itself comprises districts like Bareilly, Pilibhit, Shahjahanpur, Badaun, and Rampur—each with distinct challenges in terms of literacy, economic participation, and digital outreach.

Studies from international contexts further strengthen the premise that digital education can act as a lever for sustainable development. For instance, Ilomäki, Paavola, Lakkala, and Kantosalo (2016) highlighted that digital competencies are central to students' ability to participate meaningfully in knowledge societies. Similarly, Arora and Rangarajan (2020) argued that in the Global South, digital education is not merely a pedagogical shift, but a developmental imperative, linked closely with employability, gender equity, and digital citizenship.

In a study published in *Computers & Education*, Selwyn and Facer (2013) emphasised that while digital education promises scalability and flexibility, its real-world impact is mediated by human, infrastructural, and governance

factors. Their argument gains significance in the Indian scenario, where technological readiness is not uniformly distributed. In Uttar Pradesh, particularly in the Rohilkhand zone, the digital landscape remains patchy. Despite government-led efforts such as DIKSHA, e-Pathshala, and PM e-Vidya, gaps in electricity, teacher training, device accessibility, and regional-language content continue to obstruct the promise of digital inclusion (Pandey & Sinha, 2022).

Moreover, the role of digital education in achieving SDG 8—focused on decent work and economic growth—cannot be understated. Skill-based e-learning platforms and vocational digital courses are increasingly shaping labour market outcomes. A recent paper by Hinojo-Lucena, Aznar-Díaz, Cáceres-Reche, and Romero-Rodríguez (2019) observes that digital upskilling enhances employment prospects, especially among youth and marginalised populations. For regions like Rohilkhand, where traditional employment opportunities are constrained by agricultural dependency and low industrialization, digital education could pave new pathways for economic mobility and resilience.

What remains largely underexplored, however, is the micro-level impact of digital education initiatives in specific Indian sub-regions like Rohilkhand—how local actors perceive, adopt, and adapt digital learning modalities, and whether these interventions are aligned with the broader aspirations of the SDGs. Despite promising macro-level trends, regional asymmetries in access, digital literacy, and educational quality continue to impede inclusive development. Thus, this study undertakes an empirical inquiry into the role of digital education in advancing SDGs, focusing on both qualitative and quantitative insights drawn from the educational ecosystem of Rohilkhand.

In this pursuit, it becomes important not merely to quantify access or enumerate platforms, but to interpret the lived experiences of educators and learners, their aspirations and frustrations, their digital anxieties and affordances. The intersection of global policy (i.e., SDGs) and local reality (i.e., Rohilkhand) forms the crucible in which the real impact of digital education must be understood. In doing so, this research attempts to contribute not just to academic discourse, but to the practical redesign of digital education strategies in the Indian context.

Despite a growing body of global and national literature linking digital education to Sustainable Development Goals (SDGs), especially SDG 4 and SDG 8, significant gaps persist in understanding how these frameworks translate into outcomes at the sub-regional level. Most studies focus on urban or Pan-India analyses, overlooking region-specific dynamics such as infrastructural disparities, socio-cultural barriers, and local policy implementation challenges-particularly in rural zones like the Rohilkhand region of Uttar Pradesh. Moreover, while the role of digital tools in enhancing access and employability has been explored, there is limited empirical work examining user perceptions, institutional readiness, and the interplay between digital literacy and community-based learning outcomes. The absence of micro-level, ground-up studies in semi-urban Indian contexts leaves a critical gap in policy design and implementation strategies for equitable digital education.

Research Objectives

- To examine the impact of digital education initiatives on the accessibility, quality, and inclusiveness of learning experiences in the Rohilkhand region with specific reference to Sustainable Development Goal 4 (Quality Education).
- To analyse the extent to which digital education enhances employability, digital skill development, and economic participation in alignment with Sustainable Development Goal 8 (Decent Work and Economic Growth) in the local context.
- To evaluate the perceptions and preparedness of academic stakeholders in the Rohilkhand region toward integrating digital education as a catalyst for sustainable development.

Review of Literature

International Frameworks Linking Digital Education and SDGs

The seminal Qingdao Declaration (UNESCO, 2015) laid critical groundwork by acknowledging information and communication technologies (ICTs) as pivotal in realizing SDG 4. It underscores access, quality assurance, teacher training, and open educational resources as essential pillars. This framework is reinforced by the Incheon Declaration (UNESCO, 2015), which emphasises distance learning innovations, MOOCs, and digital content quality—pointing

toward global commitment at that time. Researchers exploring development education in India has also begun linking school-level learning with broader sustainable development discourses. The study “Protecting the future: The role of school education in sustainable development” (International Journal of Development Education & Global Learning, 2016) assessed how environmental education delivered via schools can influence community awareness and resilience. Together, these works illustrate early recognition of digital pedagogies as transformative vehicles for inclusive education.

Early Empirical Insights and Digital Divide Concerns

By 2017, scholarship began to critically address the assumption that digital solutions alone ensure inclusion. Lingering digital gaps were highlighted by Hilbert (2019), illustrating that disparities in device access, language content, and connectivity can widen educational inequalities—a direct foil to SDG 10 aspirations. In parallel, Vinuesa et al. (2019) produced one of the first comprehensive bibliometric analyses linking AI and digital tools with SDG targets, revealing both enabling potentials and unintended consequences such as digital exclusion and data privacy challenges.

Conceptual and Systematic Reviews

A surge of systematic literature reviews began to consolidate fragmented insights. Castro et al. (2020) introduced challenge-based learning within e‑learning frameworks, showing how pedagogical innovation can bridge higher education and SDG awareness. García‑Hernández et al. (2022) conducted a broader review of "Sustainability in Digital Education", identifying key dimensions—digital innovation, inclusive pedagogy, and ICT-integrated curricular frameworks—that positively influence SDG outcomes. This aligns with research indicating the underutilised role of universities as SDG agents through curricular transformation and community engagement initiatives. Green IT solutions in digital learning environments (Vakaliuk et al., 2020) argues for sustainability-conscious digital design, combining cloud-based systems with pedagogical resilience—though much of this literature emerges from Ukraine and Europe rather than South Asia

Digital Justice, Equity, and the Just Digital Paradigm (2021–2022)

Scholars like Castaño (2021) and Selwyn & Facer (2013) influenced thinking on digital justice—conceptualising equitable access as a matter of rights and

design. The "just digital" framework (Eubanks et al., 2021) argues that fair distribution of devices, affordable infrastructure, and inclusive policies are preconditions for realising SDG-aligned outcomes. While upper-middle-income countries can implement digital infrastructure at scale, the justice lens emphasises adaptive design for vulnerable learners in rural contexts like Rohilkhand.

Intersection of Digital Skills and Economic Empowerment

The nexus between digital literacy and employability has received growing attention. Hinojo-Lucena et al. (2019) demonstrate that e-learning and digital upskilling lead to enhanced job prospects, especially for youth. Simultaneously, Wagner (2018) highlighted the role of digital inclusion in reducing educational inequalities, pointing to both quality (SDG 4) and economic relevance (SDG 8). These studies create a strong theoretical base for understanding digital education as an enabler of decent work through credentialing, skill certification, and remote employment.

Indian Case Studies: Rural Innovation & Policy Push

More recent case-based research emphasises context-specific models in India. Yadav & Yadav (2024) set forth IT-based implementation strategies for SDGs, showcasing how Bareilly-based interventions can guide localised digital transformations. Similarly, a 2025 investigation into digital frameworks concluded that digital education works only when technology support, local language content, and cultural norms are thoughtfully integrated. Foundational work by Urvashi Sahni (Study Hall) and Sampark Foundation highlighted blended digital audio-classrooms and smart-TV modules that pair low-cost tech with teacher training in rural Uttar Pradesh.

Emerging Paradigms: Education 5.0 and AI Integration

The concept of Education 5.0 has gained traction as a futuristic model that merges AI, VR/AR, and student-centric pedagogy for sustainable learning. UNESCO's 2023 "AI Competency Framework for Teachers" enhances this vision, underscoring the need for educators to manage digital toolkits skillfully. While these developments remain in nascent theory and urban pilot zones, they provide a directional template for Rohilkhand's inclusion in larger digital education ecosystems.

Synthesis and Observations

- Global declarations (Qingdao, Incheon) laid policy foundations emphasising access, quality, and teacher support.
- Digital divide literature (2017–2019) cautioned against technology-focused optimism and emphasised contextual limitations.
- Systematic reviews (2020–2022) synthesised digital pedagogy, sustainability-linked ICT design, and university–community interfaces.
- Digital justice frameworks offered critical equity lenses, relevant to under-resourced areas.
- Indian context studies illustrate grassroots digital innovation coupled with policy agency, highlighting replicable rural solutions.
- State-of-the-art education paradigms (Education 5.0, AI frameworks) signal forward-looking integration, albeit yet to be fully tested in similar rural settings.

Research Methodology

This study employed both primary and secondary data to explore the role of digital education in advancing Sustainable Development Goals (SDGs) within the Rohilkhand region of Uttar Pradesh. Primary data were collected through a structured survey administered to 159 respondents from the academic field, including teachers, administrators, etc. The sample was selected using purposive sampling to ensure relevance to the study's educational focus. Quantitative responses were analysed using descriptive statistics to assess access, quality, and the perceived effectiveness of digital learning tools in relation to SDG 4 and SDG 8. Secondary data, consisting of qualitative information, were gathered from government reports, academic publications, and policy documents to contextualise the findings and strengthen interpretative validity. This dual-source design allowed for both empirical insights and comparative analysis grounded in existing literature.

Data Analysis

Objective 1: Impact on Accessibility, Quality, and Inclusivity (SDG 4)

Digital Access & Device Availability

From the survey of 159 academic professionals -teachers (75%), and administrators (25%), computer or smartphone access in institutions varied significantly: nearly 80% in Bareilly and Pilibhit had consistent internet-enabled devices, whereas Rampur and Badaun also showed similar pattern. Device-sharing patterns within households also emerged. These data exposed persistent structural inequities in device and infrastructure availability, underscoring a foundational barrier to achieving equitable access under SDG 4.

Quality of Instructional Delivery

Respondents consistently rated classroom interactivity higher when using digital resources. On a 5-point scale, blended content with recorded lectures scored an average of 4.1 compared to 3.2 for traditional lecture methods. Notably, synchronous sessions conducted via educational platforms (e.g., DIKSHA, PM e-Vidya) were perceived as more inclusive for rural learners, enabling guest lectures from outside Rohilkhand. However, over 60% of respondents highlighted limitations in local-language content and frequent connectivity failures, which diluted overall quality and scalability.

Inclusivity & Learner Engagement

Qualitative feedback painted a vivid picture: some respondents described that recorded classes allowed students in remote hamlets—who regularly missed class due to transport issues—to "rewatch lectures at their own time," fostering more equitable participation. Meanwhile, they emphasised the importance of regional dialect support, noting that students benefited from bilingual instruction. Yet, respondents also flagged xenophobic or caste-related resistance in certain villages, showing digital tools alone are insufficient without cultural acknowledgment and trust-building within marginalized groups.

Objective 2: Enhancing Employability and Economic Participation (SDG 8)

Digital Skill Acquisition

A critical cluster of survey statements probed attainment of specific digital competencies. Over 70% of respondents rated themselves and their students as "competent" in basic digital literacy—creating documents, navigating web browsers, and participating in online classrooms. Yet only 25% felt confident in advanced skills: spreadsheet analytics, coding, or digital marketing tools. This competency gap could limit the capacity of Rohilkhand learners to meaningfully engage in modern economic sectors.

Certification & Career Outcomes

Some respondents had completed official e-certifications (e.g., NPTEL, Coursera, Swayam or other MOOCs platforms) in the past years. They also reported that such credentials positively influenced job placements or internships.

Institutional Support & Ecosystem Mapping

Data from institutional documents and interviews complement survey findings. For instance, the almost all institutions have established “computer labs” equipped with internet connectivity, scanners and printers to support e-application processes-a tangible intersection of digital skills and socioeconomic access. However, staffing issues (for instance lack of IT facilitators)have hampered full deployment. Private institutions and computer centers are also offering Microsoft Office and Tally certificate courses, revealing how these entities are crucial actors in the SDG 8 ecosystem.

Objective 3: Stakeholder Readiness & Perceptions

Preparedness of Academics

The overall readiness for digital education in the region varied based on factors like teacher training, confidence in using digital tools, and attitudes toward new teaching methods. Some areas appeared to be more prepared and open to digital education, while others were still facing challenges in adapting. Many educators were yet to receive formal training under the initiatives introduced by recent education policies, which had affected how smoothly digital learning is being implemented. Few respondents shared that

digital learning often feels like a temporary solution rather than a well-established system, pointing to a gap between what policies aim to achieve and how they are being put into practice on the ground.

Attitudes Toward Digital Education

Interviews (unstructured) with faculty members revealed a clear pattern: while most educators agreed that digital tools can enhance the learning experience, many still felt that traditional classroom teaching remains essential, especially for younger or early-stage learners. In addition, they also pointed out a gap between national-level strategies and the actual ability of local institutions to carry them out effectively. They emphasised that digital tools should be adapted to local needs and conditions, rather than simply adopting global platforms without customization.

Readiness of Institutions

An evaluation of digital infrastructure across the region showed mixed levels of readiness. While some colleges were better equipped and more consistent in maintaining their digital systems, others faced frequent interruptions and challenges. Common issues included unreliable power supply and slow internet connectivity, which affected the smooth functioning of digital education. Despite these obstacles, many institutions expressed a willingness to improve and showed interest in collaborating with external organisations. Their openness to working with NGOs and corporate programmes suggests a promising opportunity to strengthen digital literacy and support broader efforts aligned with sustainable development goals.

Cross-Objective Analysis & Region-wide Patterns

Connectedness between Access and Outcomes

Region-wide data indicate a clear correlation: institutions with stable digital infrastructure (e.g., Bareilly) exhibited higher levels of digital certification, greater faculty readiness, and more student job placements. Conversely, weaker infrastructure in other areas correlated with lower scores across SDG 4 and SDG 8 metrics.

Policy versus Ground Reality

While national education policies and digital initiatives offer ambitious plans for transforming learning, putting these ideas into practice continues to face

several challenges. Differences in how these programmes are carried out can be seen across institutions, often influenced by language barriers, varying levels of teacher readiness, and the need for better support systems. In many cases, educational content was not fully adapted to meet local needs, and regular training for educators was still lacking. These gaps make it difficult to realise the full potential of digital education on the ground.

Communities as Anchors of Trust

Feedback from participants suggests that community-driven efforts to promote digital literacy, often led by motivated educators or supportive local groups, play a valuable role in strengthening formal digital education programs. In some areas, simple digital tools placed in shared community spaces were effectively used by students for learning and exam preparation. These grassroots efforts showed how blending local involvement with digital resources could create meaningful learning opportunities and build trust within communities, offering a promising approach to inclusive and accessible education.

Discussion of Findings

The data reveal a nuanced picture: digital education in Rohilkhand is indeed a powerful accelerator of SDG 4 and SDG 8—but its efficacy remains uneven, contingent on infrastructure, human capital, socio-cultural readiness, and institutional will. Where these elements align, digital learning fosters not just academic quality, but also tangible economic uplift and entrepreneurial potential.

The role of digital education in promoting Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth), in the Rohilkhand region of Uttar Pradesh reveals a mosaic of progress, promise, and persistent gaps. Based on the triangulated analysis of survey data, stakeholder interviews, and regional institutional studies, the following core findings emerge:

A consistent pattern observed across the region is that the quality and reach of digital education are directly proportional to infrastructural readiness. Institutions, where digital labs, power backup, and consistent internet were available, reported significantly higher student engagement and faculty satisfaction with digital tools. In contrast, where there is lack of all digital

facilities required shown lower digital integration, which translated into limited access and lower digital literacy outcomes.

Digital equity in education is not merely about device access but about a well-functioning infrastructure ecosystem. Without stable electricity, high-speed internet, and device availability, the promise of inclusive education under SDG 4 remains aspirational. This confirms prior assertions by Hilbert (2019) that technology magnifies existing inequities when unevenly distributed.

Respondents across the region noted that digital tools, especially blended learning approaches,enhanced engagement, personalised feedback, and learning flexibility. However, challenges like unfamiliar digital interfaces, language barriers, and culturally irrelevant content diluted this effectiveness in more rural pockets. While some students benefited immensely from recorded lectures and e-content, others struggled with low comprehension and digital fatigue.

The transformative potential of digital education is most evident when tools are adapted to local linguistic, cognitive, and cultural contexts. Universal digital platforms often fail to reach “last-mile” learners unless accompanied by localised content and educator mediation. The data reinforced Ilomäki et al.'s (2016) position that digital competence is not only technical but socio-pedagogical.

The study identified that students with exposure to online certification platforms like SWAYAM, NPTEL, Coursera or other MOOCs platfoms experienced improved employment prospects or access to internships. Respondents also cited high interest in such courses, but limited access due to low awareness, device availability, and guidance on navigating such platforms.

While digital education is gradually fostering economic empowerment in line with SDG 8, this growth is not organic. It needs institutional scaffolding—counseling centers, community mentors, and e-literacy campaigns. These findings echoed Hinojo-Lucena et al.’s (2019) conclusions that digital skill training correlates positively with employability but hinges on local enablement.

Some respondents reported formal training in digital pedagogy, and many admitted to relying on self-learning or improvisation. They were more likely

to have participated in workshops, while others cited a lack of exposure to structured capacity-building initiatives. Some reported low confidence in managing interactive online sessions, evaluating student progress, or using analytics tools.

Teachers are the keystone of digital transformation in education. Without ongoing digital pedagogy training, even the best tools will falter in their implementation. The gap between policy design (e.g., NEP 2020) and local teacher development reflects a weakness in decentralised professional development frameworks, echoing Mishra and Koehler's (2021) emphasis on Technological Pedagogical Content Knowledge (TPACK).

Across districts, where local actors—NGOs, panchayats, or community leaders—played a role in digital outreach (e.g., setting up smart classrooms in village centers), adoption rates and learner confidence were notably higher. In almost every city, local computer centers, private ed-tech firms are offering Tally, MS Office and other digital training courses to the local community, leading to greater participation in digital skill programmes.

Community-driven digital education models rooted in trust, language, and shared identity seem to outperform top-down digital impositions. The finding supports Arora and Rangarajan's (2020) argument that sustainability in digital education requires strong grassroots alignment.

Despite the flexibility and reach of digital tools, most respondents (faculty and students alike) stated a preference for hybrid models over fully online formats. Emotional disconnection, difficulty in doubt-resolution, and lack of peer interaction were frequently cited limitations. Moreover, some educators expressed ethical concerns about surveillance, student monitoring, and data privacy on certain platforms.

Technology cannot replace the human touch in education—it must augment it. This aligns with the emerging post-pandemic pedagogical shift that re-centers the teacher as a reflective facilitator rather than a passive content deliverer. This also suggests a broader cultural interpretation of learning that includes affect, community, and interpersonal connection as fundamental to education.

Synthesis of Findings in Light of SDG 4 and SDG 8

- In relation to **SDG 4**, digital education in Rohilkhand is expanding reach and creating new pedagogical possibilities. However, systemic

issues like poor infrastructure, inconsistent teacher training, and lack of vernacular content act as major barriers to truly equitable, quality education for all.

- Regarding **SDG 8**, digital platforms show promise in equipping youth with job-relevant skills and certifications. Still, the economic impact is currently restricted to digitally advanced sub-regions and lacks systematic pathways for rural learners to transition from certification to employment.

These findings collectively indicate that while digital education holds significant potential to catalyse SDG progress in Rohilkhand, its outcomes remain contingent on regional preparedness, educator capacity, and community-based collaboration. The region is not uniform—success in one district does not guarantee outcomes in another. Therefore, policy and practice must be adapted not only to the broader Indian educational context, but to the granular realities of each sub-region within Rohilkhand.

Conclusion

This research explored the evolving role of digital education in supporting the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth), with a specific focus on the Rohilkhand region of Uttar Pradesh. The study revealed a dynamic but uneven landscape, where digital education has opened new pathways for access, learning flexibility, and skill development—yet remains hindered by infrastructural deficits, capacity limitations, and socio-cultural disparities.

The findings confirmed that digital interventions, when contextually adapted and locally supported, can enhance educational inclusivity and support employability outcomes. However, this potential is often concentrated in pockets of relative privilegesuch as urban centers, leaving peripheral districts at a disadvantage. Teachers play a pivotal role in translating policy into practice, and their uneven preparedness further underscores the need for consistent, localized digital pedagogy training.

Importantly, the study challenged the assumption that digital education, by virtue of its design, is inherently equitable or sustainable. In practice, digital solutions must be mediated by cultural understanding, language sensitivity,

and infrastructural viability. Rather than a universal panacea, digital education should be seen as one layer in a complex matrix of educational reform that requires convergence between technology, human agency, and community participation.

Limitations of the Study

While this research provides valuable insights, it is not without limitations. First, the study relied on self-reported data, which may include subjective bias or socially desirable responses. Second, the sample size, though meaningful within the regional context, may not fully represent the diversity of educational stakeholders across all districts of Rohilkhand. Third, the study focused primarily on academic institutions and did not deeply explore the role of non-formal or vocational digital education channels that may also contribute to SDG outcomes. Lastly, as the research was conducted within a specific time frame, it may not capture the long-term impacts of digital interventions or policy shifts that are still evolving.

Future Implications

The findings of this study offered several important directions for policy, practice, and future research:

1. **Localised Implementation of NEP 2020**: National policies need to be interpreted and implemented through region-specific strategies that address the unique digital, linguistic, and infrastructural challenges of areas like Rohilkhand.
2. **Strengthening Teacher Capacity**: Long-term digital transformation in education hinges on investing in continuous teacher training programmes that are flexible, inclusive, and tailored to rural educators.
3. **Community-Led Digital Literacy Initiatives**: Future strategies must involve panchayats, local NGOs, and grassroots actors in promoting digital awareness and skills, especially among marginalized populations.
4. **Hybrid Models over Full Digitization**: A balanced blend of traditional teaching and digital innovation appears most effective. Policymakers and institutions should design hybrid learning

frameworks that are resilient, inclusive, and sensitive to learner diversity.

5. **Expanded Scope for Future Research**: Future studies could expand the sample to include students, parents, and private education providers to develop a more holistic understanding of digital education's systemic impact on SDG progress.

The future of sustainable education in Rohilkhand,and by extension, similar semi-urban and rural regions in India,depends not just on the availability of digital tools, but on how intelligently, equitably, and locally they are embedded into the educational ecosystem.

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CHAPTER TWO

Assessing the Use of Multimedia Technology in Enhancing Learning Outcomes for Students with Special Educational Needs

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Abstract

This study focused on the incorporation of multimedia in special needs education, with Kwara State's School of Special Needs in view. The objectives of the study were to examine the extent of the incorporation, perceived benefits and challenges of the use of multimedia technology in special needs education. Piaget's theory of cognitive development underlined the research work. Semi-structured interview questions were administered to the participants of this study, using a snowball sampling approach, and their responses were analysed thematically. The results showed a high level of multimedia incorporation in special needs education in the case study of this research. However, there are several impediments to its adoption. The study recommended that training and re-training for educators must be prioritised; infrastructure must be improved; and policies should be reviewed to enable a guided use of mobile learning devices and locally multimedia contents.

Keywords: Multimedia, Education, Special needs, Piaget's theory of cognitive development.

Introduction

As the world evolves in technological advancement, the ways we do things, especially in our communication process, have become much easier and more effective (Genc & Sahin, 2016). Singh (2016) noted that the evolving growth of Information Technology (IT) is amazing as its unique characteristics, especially its cost, size, speed, storage and communication capabilities, continue to benefit humanity in its economy, social, communication, health, and education dimensions. The use of multimedia technologies for effective communication has gained ground (Sousa, Richter & Nel, 2017). Multimedia has indeed become so useful in the area of education. The application of technology to make learning more interesting and understandable is no longer

negotiable. Abdul Samat and Abdul Aziz (2020) noted that the use and application of multimedia in learning, teaching, and reading is valuable, as it combines different media elements that greatly aid information processing for adequate and effective understanding.

Irika et al. (2023) opined that multimedia has greatly benefited classroom activities by easing the availability and accessibility of learning materials, benefiting both educators and learners. According to Irika et al. (2023), the use of multimedia packages and facilities via internet media in the learning process has significantly increased students' effectiveness, creativity, and motivation. Similarly, Jastaniyah and Bach (2017) asserted that multimedia is useful for both educators and learners because educators can easily access, download, upload, and share educational materials with students in a short period of time. Similarly, teachers and students can greatly benefit from the application of multimedia for the design and delivery of lectures.

Thus, the teaching and learning process can be effectively enhanced through the use of multimedia elements (Sousa, Richter & Nel, 2017; Abdul Samat & Abdul Aziz, 2020; Irika et al., 2023). However, there are various categories of learners in schools and in each classroom, whose dispositions toward education might also vary. It is therefore imperative to examine the use of multimedia technology to enhance learning outcomes for students with special educational needs.

Research Objectives

The following were the objectives of the study:

1. To examine the extent of use and incorporation of multimedia in special needs education
2. To examine the perceived benefits of using multimedia in special needs education
3. To identify the challenges of the use of multimedia in special needs education.

Literature Review

The Concept of Multimedia

The growing evolution in media technology has brought about what we called the multimedia into human communication system. As it is conceptualised by Ray and Benigno (2022), multimedia is an application that brings variations of elements such as graphics, audio and video together for the purpose of

presenting idea and at the same time making learning easier and faster. Multimedia, according to Iihan and Oruc (2016), in Turkish Language Society (TLS), is "the platform where a material is combined with text, graphs, audio, and simulation. This buttress the fact that multimedia involves the combination of media, which are integrated into a single package.

Raffat et al. (2015) defined it as the representation of multidimensional way of communication and Sousa (2017), cited Schnotz and Lowe (2003), stated that the term multimedia is the combination of multiple technical resources for the purpose of presenting information represented in multiple formats via multiple sensory modalities.

Breaking it down further, Ray and Benigno (2022) noted that the advancement of technology has resulted in increasing use of multimedia not only in all dimensions of communication process, but also particularly in teaching and learning. The use of multimedia in education offers several teaching methods, such as the usage of PowerPoint for presentation, documentaries creation, and movies production. The use and application of multimedia in these ways ensure the incorporation of text, graphics, audio, video, as a presentation involving audio and video clips would be considered a multimedia presentation (Ray and Benigno, 2022).

Multimedia in Education

A major challenge of learning process in most schools has been the lack of learning media, which in ideal situation when put to use, helps to overcome students staying less active and less interested in learning (Yudhie, Eka, Oding, & Layung 2022). In defining multimedia fitting into education use, Sousa (2017) expresses that multimedia is a technological package that helps teachers/lecturers to put text, graphics, animation, and other media into one package in order to achieve a comprehensive information presentation.

Yulyani, Arisanti, Fitria and Desyandri (2020) remarked that multimedia is greatly useful for enhancing self-study, providing an affective climate for learning where individual can gain meaning that is more affective and unforgettable. Thus, multimedia increases learning motivation; provides feedback and allows individual control - when it is being used Yulyani, Arisanti, Fitria and Desyandri (2020).

On a broader assessment, multimedia is one of the most complex and versatile digital learning media for creating knowledge and enabling a sensory learning environment, which, in turn, helps students to learn better by integrating

information (Olufunke, Harun & Zakaria, 2022). According to these scholars, the strength of multimedia is seen in its ability to emphasise on real-world experiences; thereby making learning adoptive and adaptive. Expatiating this further, learning, while having fun, is possible, distinctive and mostly in isolation from the media. This clearly implies that multimedia use for learning can create an authentic learning environment where attention is sustained (Tajeri, Syal, & Marzban, 2017) and learners find learning engaging, fascinating and fun- filled (Yang & Baldwin, 2020).

Chong (2019) opined that multimedia use in education has increased students' motivation and engagements, thereby resulting in increased assimilation of knowledge (Radianti, Majchrzak, Fromm & Wohlgenannt, 2020) and enhanced learners' academic attainment (Tajeri, Syal, & Marzban, 2017). Furthermore, multimedia does not only provide opportunities for students to construct their own knowledge (Fatirul, 2020), it also improved students learning outcomes (Lin, & Lin, 2019).

Multimedia Technologies for Learning

The advancement in computer speeds and storage space has made multimedia a commonplace today (Ray & Benigno 2022) such that its incorporation in learning has become highly popular. Raja and Kumar (2010) reinstated that the use of multimedia for teaching is strategic as it comprises more than one instructional technique for engaging teaching because different media are put to use during teaching and learning activities with students. These media include things which are strategically manipulated, things that can be seen, heard, read or spoken. Also, Xuan, Siti and Quan (2023) noted that digital tools, such as tablets, software applications, video and audio tools, interactive whiteboards, and online platforms, which are reflection to multimedia packages, are effective for educators' teaching delivery.

Therefore, multimedia technologies for learning include: Instructional Software, Enterprise Management Software and Student Information Systems, Global Positioning Systems, Classroom Administration, and Digital/Online Content, and Data Warehouses, Interactive Whiteboards and LCD Projectors, Sound Enhancement, Smart Cards, , and Digital cameras (Jastaniyah, 2017).

Overview of Different Types of Children's Disabilities and Special Needs

Khushaboo and Kavita (2022) considered children with special needs as those who have a disability in some areas and need special support and care. They further opined that the categorisation of these children's disabilities determines

their special needs. The categorisations include: physically disabled children, mentally disadvantaged children and socially maladjusted children. Similarly, children can suffer different arrays of impairment, and thus, there are visual impaired children, hearing impaired, children with impaired speech and mentally challenged children Khushaboo and Kavita, 2022).

Similarly, Malam and Malama (2021) noted that special needs categorisation result from disability, which on a broad assessment are consequence of an impairment that may be cognitive, physical, mental, sensory, emotional and developmental. Children with disabilities vary (Ringø & Emil, 2025) in respect to the type, number of disabilities, cause, degree, alongside the effect it has on the children education. Some children have specific deficiencies such as: reasoning, learning, spelling, calculating, reading, listening and writing difficulties. However, the main defining characteristic of these children is that for their learning difficulties, specialised education is mostly and importantly required in order to meet their needs (Jeneffer et al., 2022)

Therefore, there are various educational settings for children with special needs (Malam and Malama, 2021). Thus is to say that the necessity for a special needs school is the best option to attend to this distinctive disability of children. The school is expected to have capacity to cater for students who have special educational needs as a result of their physical disabilities, low cognitive development and behavioural problem (Peta, Lisa, Susan, Natalie & Aisha, 2023). Special schools are specifically structured and staffed with concern for special education for children with special needs (Khushaboo & Kavita, 2022). Such schools are special in their structure and process which are meant to cater for the needs of the children who have difficulties in acquiring academic skills such as reading, spelling, writing, speaking, understanding, listening, thinking or arithmetic (Jeneffer et al., 2022).

Multimedia Applications in Learning for Children with Special Needs

For children with special needs, the positive effects of technology have even been clearer and much more positive than for the general school-age population (Christodoulos, 2023). Peta, Lisa, Susan, Natalie and Aisha (2023) noted that children with special needs usually require additional assistance and care in opportunities for learning, communication, mobility, interpersonal interactions and relationship building. This explains why the use of technology is increasingly becoming a strategy for supporting young children with special needs.

Multimedia software and multimedia learning environments have been proven to be effective in helping children with disabilities to develop skills in domains as varied as academic domains of literacy and numeracy, life skills and social interaction (Sousa, Richter & Nel, 2017). Therefore, different multimedia applications can be used to enable t disabled learners adopt their own style of learning as human brain learns using many senses such as sight, hearing or touch (Raja & Kumar, 2010). Sousa, Richter & Nel (2017) added that lecture that integrates pictures or video images can help children with disabilities to learn and retain information much more effectively.

Since the cognition strength and ability of learners varies, multimedia element can enhance learning by any category of learners (Tajeri, Syal, & Marzban, 2017). This means that multimedia approach to teaching is a strategy that comprises more than one instructional technique for teaching. Thus, different multimedia applications can be used to present disabled learners with visual, auditory or kinesthetic experiences, thereby helping them to adopt their own style of learning. Such multimedia include: audio, visuals, such as videotapes, television, computers, motion pictures, and regalia, such as globes specimens, models, kits. There is also instructional media that are mainly projected, such as slides, transparencies, projectors, and those that non-projected media, such as chalkboards, bulletin / magnetic boards, photographs, pictures, charts. All these can benefit learners that are challenged in different ways because the multimedia can provide a variety in learning.

Tajeri, Syal, & Marzban (2017) also identified educational media namely print media to include books, programmed texts, flash cards, electronic media or the non-print media, which include CCTV, computers and other machines that help greatly in overcoming physically-challenged children' learning problems.

Christodoulos (2023) emphaisesd that students with physical disabilities learn more easily through the use of assistive technology such as the use of eyelid switches or other communication devices that replace speech. Also, students with learning difficulties are able to achieve cognitive access by using appropriate software on the PC, which enhances digital use of image or video with written text.

In the same vein, Israel et al.'s (2014) work on supporting content learning through technology for students with disabilities revealed that, in the past decades, two types of overlapping technologies have been most prevalent in supporting students with disabilities and other struggling learners: AT and IT (Assistive Technology and Instructional Technology) respectively. According

to them, these technologies have an array of functions, such as speech recognition software, which is highly beneficial for students with dysgraphia or dyslexia, and is routinely acknowledged as AT for students with disabilities. They also noted that this same technology is ubiquitous on current smartphones and other mobile devices that people without disabilities use on a daily basis.

Benefits/Effects of Multimedia Incorporation for Special Need Education

Due to the strength of multimedia in its ability to provide two or more media elements in a single compartment, it offers its users undeniable benefits. The different dimensions of the benefits of multimedia to special needs education have been confirmed by various scholars.

Mohamad and Saleem (2023), in their work, observed that the use of technology like multimedia helps greatly in learning. As learning using visual aids is expedient for children who have particular requirements, such as students with special needs who struggle with abstract cognition and retention capacity, the instructional tools or media can be tailored to accommodate these challenges.

Eka, Dwi and Yoga (2023) also examined the effectiveness of multimedia-based learning materials for deaf students in online learning and find out that hearing impairment experienced by deaf students has an impact on language and academic development. However, multimedia has been able to take into an account the theoretical and research bases of learning for people in this category of impairment. Therefore, interactive multimedia tools are confirmed to lead to a significant increase in reading skills among students with specific learning difficulties.

Also, Iyamuremye, Nsabayezu, Mbonyiryivuze and Mbonyubwabo (2023) discovered that the use of technological tool facilitates the process of mathematical exploration. Stressing that with these specialised approaches to teaching, most disabled learners can be helped to learn normally.

Joei & Noraffandy's (2022) study revealed that audiovisual context has progressed into a new approach that sharpens the analytical reasoning and rational social skills of special needs students. Their study proved that multimedia technology in learning can assist students with learning disabilities, as it could benefit autistic students, thereby demonstrating the educational potential of a multimedia system.

Challenges of Multimedia Use in Special Needs Education

Despite the wide arrays of benefit that multimedia offers in the area of special needs education, there are observable challenges as well. Prominent among the challenges is the fact that the development of multimedia resources for this special population is still limited as it is considered not commercially viable to develop the media for this market; and this has also hindered the integration of multimedia technology in special education classes (Jeneffer et al., 2022).

Also, it has been confirmed that the software is usually too difficult for children with learning disabilities while in classes (Jeneffer et al., 2022). Often, it is the special education teachers that interact with the software through demonstrations rather than the students engaging with the multimedia programmes themselves.

Khan (2010), however, argued differently. He observed that autism and Down's syndrome children cannot translate the use of multimedia into learning, but they do often have enjoyable moment when exposed to multimedia.

Theoretical Framework

Piaget theory **(**1936) proposed that children pass through cognitive development stages, which are basically four, the sensorimotor, preoperational, concrete operational and the formal operational stages. These four stages are initially being influenced by a schema- a basic building block that helps to form a mental representation of the world (McLeod 2018, cited Piaget 1952). This is a way of organising knowledge that leads to a process of adaptation consisting of assimilation and accommodation.

For intellectual growth, the point of assimilation is when the existing schema is dealing with a new situation. Whereas, accommodation comes when the existing schema does not work and needs to be changed in order to deal with a new object or situation (McLeod, 2018).

Viewing special needs children in the light of Piaget's theory of cognitive development, it can averred that there is an existing building block of knowledge around such children, too- only that they need to be introduced to this block of knowledge in a different situation.

Paul (2016) thereby stipulated that multimedia approach of instruction (audio, video, graphics, internet, animations etc.) is essential for effective and efficient learning because in any learning situation, the more the senses are

stimulated, the more the person learns and the longer he retains what he learns. Buttressing this assertion, Paul (2016) added that multimedia , including Power Point presentations, can be used to encourage students to work in groups, express their knowledge in multiple ways, solve problems, revise their own work, and construct knowledge.

Methodology

The research design for this study was qualitative with a case study method, using learners with special needs. This group was singled out with the aim of assessing the benefit of incorporating multimedia on their education. Therefore, the implementation of this design and method was in line with the research objectives of ascertaining the use of multimedia and exploring the benefits and challenges of its use in special needs education.

Kwara State School of Special needs was used as the case study. An in-depth interview was conducted with five (5) educators/ instructors. Using five interviewees is supported and approved as acceptable by Creswell (2012) who recommended a sample size of at least 5 to 25 participants. Using the few participants also became necessary because of the unwillingness of most educators to grant the interview. Purposive and snowball sampling approach was used to get the five participants that eventually gave their consent to participate in the study. The interview was conducted for the participants mostly via WhatsApp where the interview questions were shared and answered. Data were analysed through the thematic analysis approach that enabled a robust process of identifying the reoccurring patterns, themes and insights from the data.

Data Analysis

Table 1, 2, and 3 and Figure 1, 2, 3 indicate all the main themes and sub-themes which answered each of the research questions.

RQ1: To examine the extent of use and incorporation of multimedia in special needs education
Table 1: Use of Multimedia in Special Needs Education

Themes	Sub-themes	Key Insight
1. Accessibility and incorporation	Incorporation of multimedia equipment	equipment such as projectors, computers, and video displays are introduced; but usage is not consistent
2. Barriers to effective incorporation	Lack of teacher training	Most educators lack the training needed for effective use of multimedia.
	Infrastructure challenges	Poor electricity supply and faulty solar systems hinder incorporation

Source: Developed from the study's data

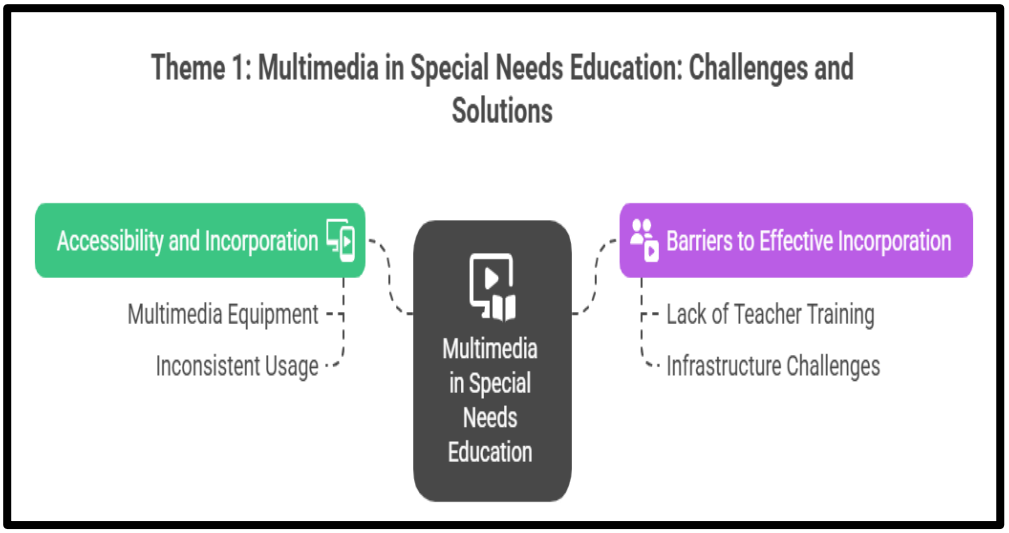
Theme One: Accessibility and Incorporation

Sub- theme: Incorporation of Multimedia Equipment

All the five Informants indicated that multimedia had already been introduced in their school, although their reflection on it was indicated in different extent. Informant 1 indicated "the use of laptops, projectors and learning videos to aid learning for children with disabilities". Informant 2 revealed "the use of gadgets, such as computerised systems, televisions with video display systems, and interactive materials for rhymes and for recognition of objects". However, Informants 3, 4 and 5 simply stated that basic computer systems were available with Informant 4 indicating that they were not available to learners and Informant 5 indicating that there were no ICT trained teachers and that power problems often disrupted the process of using the multimedia equipment for teaching and learning .

This finding implies a moderately high level of incorporation of multimedia technologies in the special needs education in the school used as the case study. Although the tools were available, knowledge on how best to handle the infrastructure were constraints to their utilitisation. This aligns with the perspective of Al-Azawei et al. (2022) as they noted that availability is not the single factor impacting the successful integration of multimedia in education, but it is strategic inclusion, such as the competence of the teachers and access by the learners. Moreover, Adebayo and Omolayo (2021) noted that the

availability of educational tools should never be confused with their proper usage unless there is proper pedagogy training and curriculum adjustment. And this is a factor that was unanimously and clearly presented in the majority of the participants' responses.



Theme Two: Barriers to Effective Incorporation

Sub- theme 1: Lack of Teacher Training

Informants 4 and 5 specifically noted that most teachers have little or no training on the use of multimedia equipment, and this is a serious constraint in classroom learning. Abdullahi and Ajayi (2023) similarly emphasised the importance of the digital competence of teachers in the context of enhanced learning outcomes in special education. This implies that the application of multimedia tools in the absence of training only makes it under-used or misused, and at the end, learners with disabilities are less attended to.

Sub- theme 2: Infrastructural Challenges

Others issues cited by the informants are poor electricity and solar back-ups, which are not functional, and, which, in turn, affect the effective use of multimedia. According to Nwachukwu and Obielodan (2021), unstable power supply and insufficient ICT infrastructure are greatest obstacles to digital tools usage in schools in Nigeria. They added that, such infrastructural issues, as confirmed by the informants in this study, pose greater challenges on special education units.

RQ2: To examine the perceived benefits of using multimedia in special needs education

Table 2: Perceived Benefits of using Multimedia in Special needs Education

Themes	Sub-themes	Key insight
Increased Engagement	Enhance attention and focus	Multimedia keeps learners focused and reduces distractions through visual appeal like cartoons, videos, and real-world representations
	Active and keen participation	Multimedia encourages interaction, expression of ideas, and smooth teacher-learner relationships.
Improved Comprehension	Visual learning for better understanding	Learners comprehend better using images, visual aids, and demonstrations—especially beneficial for hearing-impaired or developmentally delayed students.

Source: Developed from the study's data

Theme one: Increased Engagement and Classroom Participation

Sub- theme 1: Enhance Students' Attention and Focus

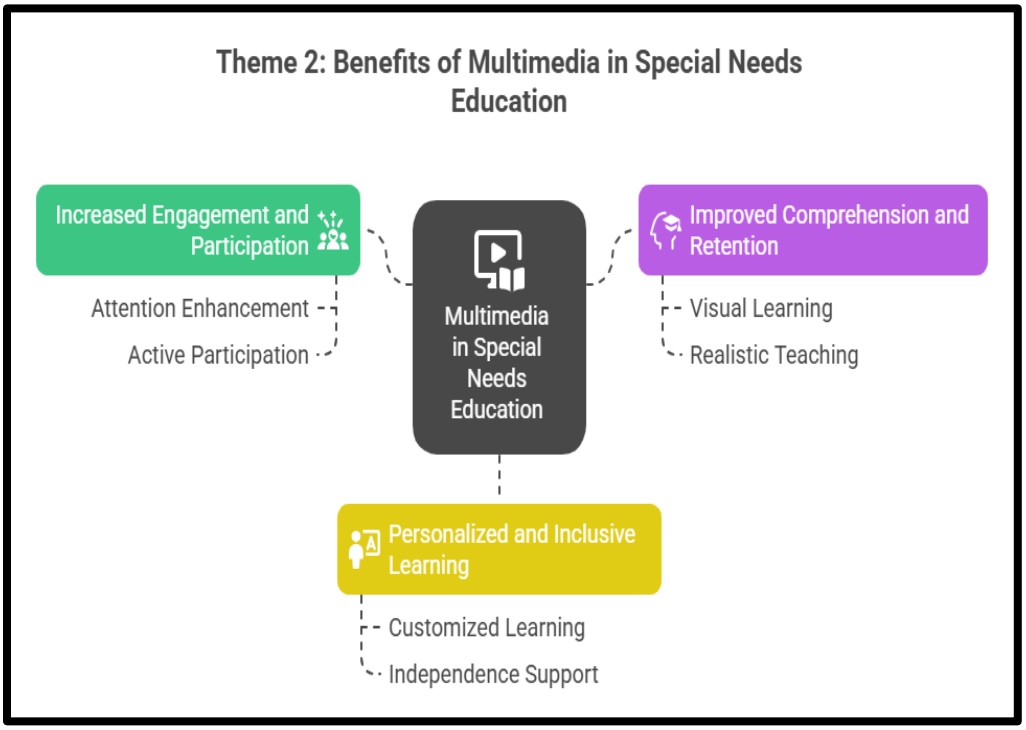
According to Informant 5, televised contents draw learner attention and make them eager to remain in the class. Informant 4 also noted that multimedia keeps the learners at the edge of their seats and thus minimises distraction. This outlines multimedia strength in keeping the learner focused particularly during learning; and, thus, children with attention deficiency ADHD or autism are well catered for. This justifies Alqahtani et al.'s (2021) opinion on

multimedia use in the classrooms as having ability to enhance visual and audio stimuli, thereby reducing distractibility in the classroom and encourage the students with cognitive and sensory discrepancies to stay focused for a longer period.

Sub- theme 2: Active and Keen Participation

Informant 2 said that "multimedia helps students to express opinions, which means that the process of learning gets more interactive and democratic". Informant 4 also noted that "multimedia enhances cordial interaction among teachers and learners." This is in concordance with Hassanzadeh & Jafarigohar (2020) who discovered that learning atmospheres supported by multimedia can transform passive participants into active participants particularly in inclusive environments where learners require different level of support.

Theme two: Improved Comprehension and Retention



Sub- theme 1: Visual Learning for Better Understanding

Informant 1 noted that pictures and videos help greatly to improve understanding. Informant 3 stressed that the children with hearing impairment remember what they see more than what they hear. Informant 5 said that visual aid illustrating math lessons enhances comprehension. According to this informant, multimedia also serves visual learners, as it is helpful especially in special education where students might be auditorily impaired or cognitively impaired. Adu-Gyamfi & Ofori-Ampong (2022) confirmed this finding by noting that visuals, simulations, and animations develop mental models to facilitate long term memorisation of an abstract or complex issue**.**

Sub- theme 2: Realistic and Simplified Teaching

Informant 3 revealed that "multimedia tools like graphical images and videos can make teaching process easy, when real thing or procedure is presented. Informant 4 also said that it simplifies and makes teaching a reality. Experiential learning can be done using multimedia tools where abstract concepts can be visualized, using real-life simulations or through dramatised real-life content". Al-Azawei et al. (2022) stated that not only does the multimedia enhance conceptual clarity and critical thinking, it also contributes to improving special needs learners who receive multisensory inputs.

Theme three: Personalised and Inclusive Learning

Sub- theme 1: Customised Learning Experiences

It was noted by Informant 1 that "with multimedia, individualised learning is facilitated and independence can be increased. Multimedia can help learners to learn at their own pace and access their preferred formats (text/video/audio) and replay on matters that they want. Abdullahi & Ajayi (2023) established in this wise that since learners with disabilities are empowered, personalised digital content ensures students with disabilities have independence, and independence is supported through autonomy and an adaptive feedback loop.

RQ3: To identify the challenges of the use of multimedia in special needs education

Table 3: Challenges of Using Multimedia in Special Needs Education

Themes	Sub-themes	Key Insight
Infrastructural	Poor electricity	Multimedia tools are under-utilised due to inconsistent power and faulty solar

Barriers	supply	alternatives.
	Lack of devices and technical resources	Schools lack adequate gadgets, funding, and maintenance support.
Human and Policy Constraints	Insufficient teacher training	Many educators are not skilled in multimedia or ICT integration.
	Restrictive device use Policies	Bans on student phone usage limit access to interactive tools like Kahoot or mobile apps that aid special education.
	Lack of specialised content	There is limited availability of multimedia content specifically designed for students with special needs.
Adaptive Strategies	Peer and one-on-one support	Teachers use peer tutoring and individualised support to help learners adjust to multimedia tools.
	Foundational ICT training for students	Basic computer literacy and exam preparation skills are taught to students to improve digital fluency and reduce anxiety around tech usage

Source: Developed from the study's data

Theme one: Infrastructural and technical barriers

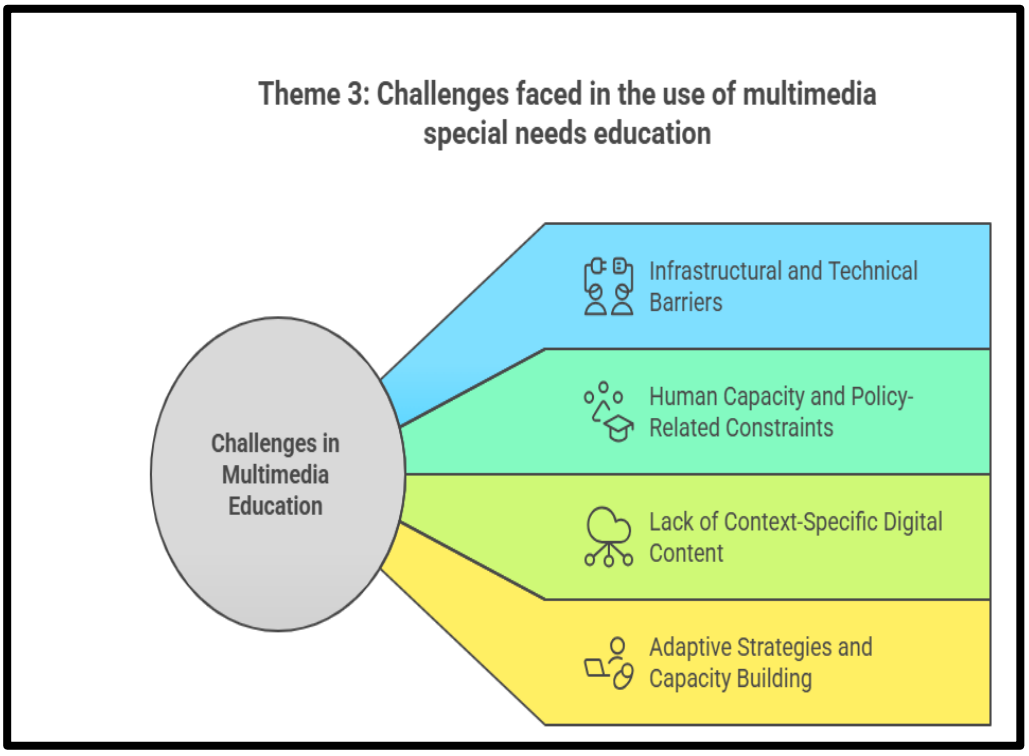
Sub- theme 1: Poor and Stable Electricity

Informants 2 and 3 cited electricity as a major constraint to the use of multimedia tools. Informant 2 called it "the poor/unstable electricity", and

Informant 3 noted "it as one of the greatest constraints. Operation of digital tools requires steady power supply". This is why Nwachukwu & Obielodan (2021) confirmed that infrastructural constraints, particularly the lack of consistent electricity, are one of the greatest obstacles to the integration of ICT in Nigerian schools.

Sub- theme 2: Lack of Devices and Technical Resources

The second Informant identified the lack of multimedia equipment, financial mismanagement, and skill deficiencies in the technical field as the major constraints to the use and incorporation of multimedia technologies in the special needs school . The unavailability of applications and gadgets was also identified as a constraint by Informant 3. Adu-Gyamfi & Ofori-Ampong (2022) similarly claimed that teachers cannot provide custom learning to tudents due to the inability to access the correct assistive technologies. This shortage is indicative of poor financing and poor systemic execution of inclusive education programme in developing countries.



Theme two: Human Capacity and Policy-related Constraints

Sub- theme 1: Insufficient Teacher Training

Informants 1, 2, and 4 identified the absence of trained staff and technical expertise as obstacles to efficient multimedia usage. In this wise, Abdullahi & Ajayi (2023) stated that most special education teachers do not receive training about applying multimedia tools in the learning process. Even those technologies which are available are not properly applied or utilised.

Sub- theme 2: Restrictive Policies on Device Use

Informants 4 and 5 complained that some policies forbid learners to use a phone, even though the use of phone might help in making educational activities easier and interesting. The use of some apps such as Kahoot has been confirmed to enhancing learning process and outcomes. Low-cost assistive technologies and mobile phones are becoming a widely used low-cost assistive technology in special education. Thus, Al-Azawei et al. (2022) cautioned that, even though mobile learning tools have the potential to facilitate self-paced and gamified learning, the integration of those tools into the classroom environment is obstructed by restrictive institutional policies.

Sub- theme 3: Lack of context-specific Digital Content

Informant 1 noted there was limited access to specialised contents, which could be tailored to the needs of special learners. The absence of localised, disability-specific educational media reduces the effectiveness of the available platforms. This is why Edeh and Iloh (2023) advocated for developing culturally and contextually relevant digital contents to engage students more effectively with diverse needs.

Theme three: Adaptive Strategies and Capacity Building

Informant 1 offered one-on-one guidance or peer support to students struggling with multimedia tools. Informant 2 said he provided training in basic digital skills such as typing and document management and helped students prepare for Computer-based Tests (CBT). These strategies reflect low-tech, teacher-led approaches to bridging the digital gap. Kebritchi et al. (2020) recommended similar scaffolding strategies in low-resource settings, where direct instruction and peer collaboration can supplement the lack of advanced infrastructure.

Conclusion and Recommendations

This study has examined the incorporation and use of multimedia in special needs. The highlight of the outcome of the examination is that multimedia has a way of catering for learners with varying special needs. Nevertheless, the incorporation and use of multimedia in special needs education is being militated by some major challenges. In the light of this, the following recommendations are presented for implementation:

1. Government and private individuals should collaborate and pool resources for ensuring availability and accessibility of multimedia in special needs education.
2. Adequate funds should be made available for effective and efficient running of schools of special needs, and especially for the procurement and maintenance of essential infrastructure that can enhance learning outcomes for learners with special needs.
3. Future research on the incorporation and use of multimedia should focus on distinctive categories of special needs children that are different from the ones used as a case in this study.

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CHAPTER THREE

Cross-Cultural AI Education: Internationalising Curriculum for Equitable Global Impact

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Abstract

This study addressed global disparities in AI education through curriculum internationalisation. Analysing AI educational frameworks across 12 countries on six continents, we identified key barriers: algorithmic colonialism, culturally homogeneous training data, English-language dominance, and context-insensitive pedagogies. The study proposed the Culturally Responsive AI Education (CRAE) framework featuring three dimensions: pluralistic epistemological foundations integrating diverse knowledge traditions, localised dataset development, reflecting regional priorities, and multilingual programming environments, reducing linguistic barriers. Our 30-month mixed-methods study examined curriculum documents from 38 institutions, conducted 54 faculty interviews, and analysed instructional materials, using comparative methods. Implementation across universities in Nigeria, Brazil, India, and Germany showed enhanced student engagement and technical mastery through connecting AI concepts to locally meaningful problems. Results indicated that the CRAE framework facilitates genuine knowledge exchange between Western and Global South institutions and has the potential to reshape the global AI development landscape to address diverse regional priorities. This research contributed to advancing educational practices that can help democratise AI innovation while preparing students to work effectively across cultural boundaries in an increasingly interconnected technological landscape. By fundamentally reconsidering how AI is taught and applied across diverse cultural contexts, this study contributed to a more equitable distribution of AI benefits globally.

Keywords: Internationalization, Curriculum, Artificial Intelligence Education, Cross-cultural Education.

Introduction

Artificial intelligence (AI) technologies are rapidly transforming societies worldwide, yet the global distribution of AI research, development, and educational capacity remains profoundly unequal (Acemoglu, 2021). While academic institutions across diverse regions increasingly offer AI education, AI education's curricula often unconsciously replicate Western epistemological frameworks, technical priorities, and pedagogical approaches (Mohamed et al., 2020). The result is a concerning homogenisation of AI education that potentially limits innovation diversity and reproduces existing power imbalances in global technology development (Birhane & Guest, 2021).

Integrating an international, intercultural, or global dimension into the purpose, functions or delivery of postsecondary education through the internationalisation process of the curriculum (Knight, 2015) presents a promising pathway to address these inequities. However, the unique challenges of internationalising AI education remain underexplored in both educational research and practice. This study addressed this gap by examining how AI curriculum could be meaningfully internationalised to promote more equitable global participation in AI development.

The research was motivated by three interrelated questions:

What are the primary barriers to effective internationalisation of AI curriculum across diverse global contexts?

1. How can AI education be restructured to incorporate diverse cultural perspectives, knowledge traditions, and regional priorities?
2. What impact does internationalised AI curriculum have on student learning outcomes and the development of culturally responsive AI applications?

Drawing on a comparative analysis of AI educational frameworks across 12 countries and an implementation study spanning four international university partnerships, the study proposed a novel framework for Culturally Responsive AI Education (CRAE). This framework offers both theoretical grounding and practical strategies for internationalising AI curriculum in ways that enhance educational outcomes while potentially reshaping global AI development trajectories.

Literature Review

Significant disparities in global AI research, development, and education have been extensively documented by different researchers. A bibliometric study by Mou (2022) found that just five countries, namely the United States, China, the United Kingdom, Germany, and Canada, produce nearly 72% of peer-reviewed AI research publications. These disparities are mirrored in educational capacity, with Agarwal *et al*., (2021) documenting that high-quality AI educational resources remain concentrated in wealthy nations and are frequently inaccessible to students in low-resource settings due to language barriers, prohibitive costs, and infrastructure limitations.

These educational inequities have profound implications for the global AI landscape. As Wang and Deng (2021) argued that "The geographic and demographic composition of the AI research community directly shapes which problems are prioritised, which datasets are constructed, and ultimately, which populations benefit from AI advances". When AI education is concentrated in a small subset of global contexts, it tends to reproduce technologies that best serve those same contexts (West *et al*., 2019).

While internationalisation has received significant attention in higher education broadly (Knight, 2015; Leask, 2015), computer science and AI education present unique challenges. Clear *et al*., (2017) identified several discipline-specific barriers to internationalisation in computing education, including the perception of computer science as culturally neutral, the dominance of English in programming languages and documentation, and the emphasis on technical skills over cultural competencies.

Despite these challenges, several promising approaches to internationalising computing education have emerged. Cross-national collaborative programming projects (Matthiasdottir & Falakmasir, 2018), integration of indigenous knowledge systems into computing pedagogy (Bidwell, 2016), and critical technical practice approaches that situate technology development within cultural contexts (DiSalvo, 2022) have all demonstrated potential for more culturally responsive computing education.

A growing body of research highlights the cultural embeddedness of AI systems. Sambasivan *et al*. (2021) document how AI technologies developed in Western contexts often fail when deployed in the Global South due to divergent infrastructural assumptions, cultural norms, and user needs.

Similarly, Birhane (2021) argued that the epistemological foundations of machine learning, including assumptions about objectivity, universality, and progress, are deeply rooted in Western philosophical traditions that may not align with other knowledge systems.

These cultural dimensions extend to AI education as well. Raji et al. (2021) analysed AI ethics curricula, finding that they predominantly centre Western philosophical frameworks while marginalising non-Western ethical traditions. Alenuma-Nimoh (2016) observed that AI educational materials frequently use examples, applications, and datasets that reflect the experiences and priorities of dominant cultural groups, potentially alienating students from underrepresented backgrounds.

While these bodies of literature offer valuable insights, significant gaps remain in understanding how to effectively internationalise AI curriculum. First, most studies of internationalization in computer science education have not addressed the specific challenges of AI education, which involves not only technical programming, but also statistical modelling, data practices, and considerations of societal impact. Second, while research has documented cultural biases in AI systems and educational materials, it has provided limited guidance on practical strategies for developing culturally responsive AI curriculum. Finally, empirical studies examining the implementation and impact of internationalized AI curriculum remain scarce, particularly those spanning multiple global contexts.

This study addressed these gaps by developing and testing a comprehensive framework for Culturally Responsive AI Education that is empirically grounded in diverse global contexts.

Methodology

This study employed a sequential mixed-methods design conducted over a 30-month period (2021-2023) to conduct a comparative analysis of existing AI educational frameworks across 12 countries. It analysed AI undergraduate and graduate curriculum frameworks from 12 countries across six continents: Nigeria, Kenya, Brazil, Chile, India, Indonesia, Germany, France, United States, Canada, Australia, and Japan. For each country, the study examined curriculum documents from 2-4 leading institutions offering AI degrees or specialisations with strong AI components (n=38 institutions total).

Data collection included:

- Analysis of official curriculum documents, course syllabi, and programme descriptions;
- Semi-structured interviews with faculty members responsible for AI curriculum development (n=54); and
- Thematic analysis of instructional materials, including textbooks, assignment descriptions, and assessment tools.

Data analysis employed a constant comparative method (Glaser & Strauss, 1967) to identify common patterns and divergences across educational contexts. We focused particularly on four dimensions of AI curriculum: (1) epistemological foundations and assumptions; (2) technical

content and skill priorities; (3) dataset selection and development practices; and (4) pedagogical approaches and assessment methods.

Findings: Barriers to Internationalization of AI Curriculum

The comparative analysis in this study identified four key barriers to effective internationalisation of AI curriculum across global contexts:

Algorithmic Colonialism in Educational Frameworks

Across institutions in the Global South, we observed what can be described as "algorithmic colonialism" in AI curriculum design. This manifested as uncritical adoption of curriculum structures, technical priorities, and pedagogical approaches developed in Western (particularly U.S.) contexts, often without adaptation to local needs, resources, or cultural contexts.

Culturally Homogeneous Training Data and Examples

Analysis of instructional materials revealed a striking homogeneity in the datasets, examples, and applications used in AI education globally. Across all 12 countries, we found heavy reliance on standard benchmark datasets developed primarily in North American and European contexts (e.g., ImageNet, MNIST, Wikipedia-derived text corpora, WEKA, etc). These datasets frequently embed Western cultural assumptions and priorities, limiting students' exposure to diverse data contexts. Even when discussing AI applications, case studies predominantly featured examples from Western contexts. Many examples are about "All our examples are about optimising

ride-sharing in San Francisco or detecting credit card fraud in New York. There were hardly discussions or examples of applications relevant to the country's context. This makes AI feel imported rather than something that the students can shape. This homogeneity reinforces the perception of AI as a culturally neutral technology rather than one that should be responsive to diverse contexts.

English-Language Dominance

Despite the global distribution of AI research and education, English remains overwhelmingly dominant in AI curriculum. Our analysis revealed three dimensions to this dominance:

1. **Programming interfaces:** Most AI libraries and frameworks use English-based syntax and documentation, creating additional cognitive load for non-native English speakers.
2. **Educational resources:** High-quality AI educational materials remain predominantly available in English, with translations often delayed or unavailable even for a bi-lingual country like Canada.
3. **Technical vocabulary:** The specialised terminology of AI has limited equivalents in many languages, forcing students to learn concepts through linguistic frameworks that may not align with their native conceptual structures.

Thus, while students are expected to simultaneously learn complex mathematical concepts, programming syntax, and English technical vocabulary; for some, the linguistic challenge may overshadow the technical content, creating artificial barriers to mastery.

Context-Insensitive Pedagogical Approaches

Our analysis revealed limited adaptation of pedagogical approaches to diverse cultural learning traditions and educational contexts. Across institutions globally, AI education predominantly employs pedagogical models developed for Western educational settings, including:

- Heavy reliance on independent project work rather than collaborative learning;
- Emphasis on competitive achievement (e.g., leaderboards, competitive challenges) over cooperative problem-solving; and

- Assessment methods focusing on individual technical mastery rather than contextual application or social impact.

These approaches often conflicted with local educational traditions and student learning preferences. In Nigeria for example, where students come from cultural backgrounds that emphasise collaboration, an AI curriculum that impose highly individualistic and decontextualized learning models from Western AI education will make many of the students struggle not because of the technical content but because of the cultural mismatch in how they are expected to learn.

The CRAE Framework: Principles and Implementation

Based on our comparative analysis, we developed the Culturally Responsive AI Education (CRAE) framework to address the identified barriers to internationalisation through three interrelated dimensions:

Pluralistic Epistemological Foundations

The CRAE framework integrates diverse knowledge traditions and epistemological approaches into AI education, challenging the assumed universality of Western technical frameworks. Key implementation strategies include:

Comparative Epistemological Analysis

Courses incorporate explicit comparison of how different cultural traditions conceptualise intelligence, learning, and the relationship between humans and technology. For example, a course module developed at the Thomas Adewumi University, Nigeria, paired Western computational perspectives on AI with Yoruba epistemological frameworks, examining how different conceptualisations of intelligence shape technical approaches to machine learning.

Integration of Indigenous Knowledge Systems

Curriculum incorporates indigenous knowledge systems as valid frameworks for approaching AI challenges. For example, an Australian-African universities' partnership can host AI courses that integrate Aboriginal and African approaches to classification and pattern recognition alongside conventional machine learning taxonomies, providing students with multiple conceptual frameworks for understanding key AI tasks.

Critical Technical Practice

Students engage in critical technical practice that questions the cultural assumptions embedded in AI systems. This approach will extend beyond conventional "AI ethics" by encouraging students to identify and challenge the cultural values embedded in technical choices throughout the AI development process. For example, understanding different cultural approaches to categorisation may completely change how the students will approach classification algorithms, such that 'technical' choices in feature selection and boundary definition will carry cultural assumptions they hadn't recognised.

Localised Dataset Development Practices

The CRAE framework emphasises the development and use of locally relevant datasets that reflect diverse cultural contexts and regional priorities. Implementation strategies include:

Local Dataset Curation Projects

Students will engage in collaborative projects to develop AI datasets representing local contexts, languages, and challenges. These projects will serve dual purposes: providing culturally relevant learning materials and contributing to the diversification of available AI training resources.

Comparative Dataset Analysis

When curriculum incorporates critical analysis of how dataset choices shape AI systems' performance across cultural contexts, students can examine how standard benchmark datasets embed cultural assumptions and how these assumptions affect model performance in diverse settings. For example, during implementations, students across geographies can collaboratively analyse performance disparities when applying standard image recognition models to photographs from different global regions, then develop techniques to address these disparities.

Context-Cantered Problem Definition

Rather than adopting standardised problem definitions from established benchmarks, course implemented in CRAE encourage students to define AI challenges based on local priorities and contexts. This approach shifts from a technology-cantered to a context-cantered perspective on AI education.

Having students identify AI applications relevant to their communities will completely transform engagement and motivate students who are previously struggling with abstract technical concepts as they will be applying those same concepts to locally meaningful problems.

Multilingual Programming Environments

To address English-language dominance, the CRAE framework incorporates strategies to reduce linguistic barriers in AI education:

The CRAE framework will support the development of programming interfaces that support multiple languages. While maintaining compatibility with English-based libraries (e.g., TensorFlow, PyTorch), these interfaces will allow students to use function names, documentation, and error messages in their primary languages, reducing cognitive load.

The CRAE framework is also engineered to support the development of glossaries mapping AI technical vocabulary across languages, not through direct translation but through conceptual equivalence. These resources will help students connect AI concepts to existing knowledge frameworks in their primary languages.

Besides, CRAE will ensure courses employ collaborative development environments supporting code annotation and documentation in multiple languages. This approach will allow students to programme in standard syntax while documenting and explaining code in their primary languages, separating linguistic knowledge from technical mastery.

Discussion: Implications for Global AI Education

The CRAE framework challenges dominant models of international education that position Western institutions as knowledge producers and Global South institutions as knowledge consumers. By recognising the value of diverse epistemological traditions and technical approaches, the framework facilitates genuine knowledge exchange that enhances AI education across all participating institutions.

This bidirectional knowledge flow has particular significance for AI, where computational approaches to intelligence have been overwhelmingly shaped by Western philosophical traditions. Incorporating diverse conceptualisations of intelligence and learning can expand the field's foundational frameworks,

potentially leading to novel technical approaches and applications.

Students in CRAE-implementing programmes are expected to demonstrate enhanced technical mastery precisely because of, not despite, the curriculum's cultural responsiveness. By connecting AI concepts to locally meaningful problems and culturally familiar frameworks, the approach reduces cognitive barriers and increases motivation, ultimately improving technical learning outcomes.

Perhaps most significantly, internationalising AI curriculum can help reshape the global AI development landscape. By preparing diverse students to develop AI applications addressing local priorities, using culturally appropriate approaches, educational institutions can contribute to a more equitable distribution of AI benefits globally.

Conclusion

As artificial intelligence increasingly shapes global societies, ensuring equitable participation in AI education and development becomes an ethical imperative. This study demonstrated that effective internationalisation of AI curriculum requires moving beyond superficial inclusion of global perspectives toward fundamental reconsideration of how AI is taught, learned, and applied across diverse cultural contexts. The Culturally Responsive AI Education framework offers a promising approach to this challenge, integrating pluralistic epistemological foundations, localised dataset development practices, and multilingual programming environments to enhance AI education globally. By addressing key barriers to internationalization, including algorithmic colonialism, culturally homogeneous training data, English-language dominance, and context-insensitive pedagogical approaches, CRAE principles can help democratise AI education and development. As AI technologies continue to transform societies worldwide, educational institutions have a critical responsibility to prepare diverse students to shape these technologies in culturally responsive and contextually appropriate ways. By reimagining AI education through international and intercultural lenses, we can help ensure that the benefits of AI innovation are shared equitably across our interconnected global community.

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CHAPTER FOUR

Attitude towards Knowledge Sharing among Library and Information Science Educators in Universities in South-west, Nigeria

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Abstract

The study investigated library and information science educators' attitudes towards knowledge sharing in Nigeria's South-West universities. The study adopted a survey research design, with a questionnaire serving as the data-gathering instrument. The study's population consisted of 480 Library and Information Science (LIS) educators working at universities in South-West Nigeria. The total enumeration of the population was used for the investigation. The data collection instrument was a questionnaire, with 334 copies found usable with a response rate of 69.5%. Data analysis was done through descriptive statistics. The findings demonstrated a positive attitude towards knowledge sharing among LIS educators. According to the findings, university administrators in South-West Nigeria should develop knowledge-sharing policies for LIS instructors.

Keywords: Attitude**,** Knowledge Sharing, LIS Educators, Practices, South-west.

Introduction

Knowledge sharing has evolved into a practice and culture that is actively employed to facilitate learning and achievement around the world. As a result, fostering a knowledge-sharing culture among teachers is critical for increasing cooperation, innovation, and continual professional growth, all of which benefit both students and instructors. Knowledge sharing is the process of exchanging information among individuals or groups of people with the goal of sharing ideas and gaining collaborative learning and experience in specific topic areas of interest to the users of the information. Educators' information sharing is a primary motivator for developing novel pedagogical approaches,

participatory learning, professional development, and enhanced curriculum design (Paiva & Quintas-Mendes, 2024; Yu, 2023; Wu, 2024; Meguro, 2024). Teachers foster a culture of innovation and pedagogical experimentation by sharing their experiences, resources, and best practices. Educators can benefit from each other's experience and know-how by sharing knowledge, and they are urged to use best practices while resolving instructional issues. However, attitude continues to be an important influence on behaviours and choices in a variety of areas of life, including schooling.

Educators' attitudes towards knowledge sharing are critical components in fostering a collaborative learning culture. Tanveer (2024) demonstrated how teachers' attitudes towards knowledge sharing encourage information sharing behaviour by allowing them to collaborate in fixing difficulties that arise in their profession. Attitude can be defined as a psychological tendency exhibited by judging a given entity with some degree of favour or disfavour. However, an unfavourable attitude towards an action or thought would be classified as negative. Positive attitudes can promote professional development, creativity, and innovation in educational institutions. It is, therefore, so critical to determine LIS educators' attitudes towards knowledge-sharing activities.

Attitudes can be cognitive, emotive, or behavioural in nature. The cognitive aspect refers to educators' attitudes about knowledge. For example, some educators feel that knowledge sharing leads to better teaching practices. The affective aspect frequently considers the feelings and emotions linked with the action, such as being excited about sharing knowledge with co-workers. However, in terms of behaviour, attitude refers to a predisposition to perform in a specific way. A favourable attitude towards information sharing may motivate an instructor to actively participate in joint projects. However, other circumstances influence the decision to share knowledge. Tella (2024) investigated further the drivers of teachers' desire to share knowledge and discovers that a healthy work environment and individual input recognition have a determining influence on educators' attitudes towards sharing knowledge. Wajid (2024) also looked into how people's feelings about the learning environment affect how they share information in the education sector. The results showed that teachers are more likely to be willing to share what they know and learn from others when they feel valued and supported.

The results show how important it is to have a positive attitude that makes teachers want to share what they know, which can help students learn better.

It is very important for LIS educators to share what they know with each other in order to improve their teaching methods, help their students do better, and make the classroom a place where everyone works together to learn. The practice involves sharing ideas, experiences, and resources, which can lead to new ways of teaching and making new curricula. According to Nya-Lin Yan (2016), knowledge sharing is when teachers are willing to build close relationships with their co-workers, which leads to sharing knowledge through teaching, research, and service. People share knowledge through writing, talking, and using technology. Writing, talking, and technology help in spreading knowledge. LIS teachers are also called "knowledge workers" because they are always creating, using, sharing, and applying knowledge. LIS teachers share what they know in many ways, such as through mentoring, working together, giving talks and presentations, holding seminars, having conversations, and getting together. They also share information through writing, such as newsletters, press releases, media advisories, book chapters, and books.

Knowledge sharing is critical in education because it allows LIS educators to successfully respond to changing educational trends. Several studies, like those by Xu and Li (2022), Adu and Olowu (2022), and Park et al. (2024), emphasised the relevance of information sharing in education. Park et al. (2024) discovered that instructors from diverse nations collaborated to sustain the quality of learning amid pandemic attacks such as COVID-19. Sharing knowledge would have been a difficult undertaking if not for technology innovation, which has enabled collaboration with co-workers from all over the globe. A variety of tools (e.g., ICT tools, social networking tools, the internet, and e-learning tools) are used to facilitate knowledge exchange, particularly in this digital age. Technology promotes knowledge exchange through internet platforms such as social media, emails, websites, forums, and Wikis. Elenurm (2024) investigated the use of social media as a medium to facilitate sharing of knowledge in optimal teaching methods in both virtual and face-to-face settings among academics.

Additionally, it is vital to determine what motivates teachers to share knowledge. Giving teachers incentives to share information can change their

attitudes a lot, making the workplace more open and collaborative. Incentives work as motivators, making teachers more likely to share what they know and have. There are many reasons why a teacher may choose to or not to share what they know. It could be about money, the state of the economy, the desire for recognition, or the level of support they get from their institution. All these factors can directly influence how they feel about sharing information. Wu (2024), for example, found that salary and material rewards can encourage teachers to share professional knowledge and experiences, which in turn leads to more collaboration and better sharing of resources among colleagues. In the same vein, Hosen et al. (2022) stressed that organisational support, especially through incentives, plays a huge role in defining teachers' attitudes towards knowledge sharing. Their study points out the need to create a safe and supportive environment, where teachers feel valued for what they contribute. One clear way to shift attitudes in a positive direction is by offering financial incentives. As Zaremohzzabieh and Mohd Rasdi (2025) pointed out, understanding what drives people to share knowledge makes it easier to tackle the barriers and strengthen the motivators. If institutions reward their teachers for sharing, it could open the door to a stronger culture of collaboration and better teaching practices across the board.

According to research, people see their knowledge as a source of power (Kundi et al., 2023). So, giving up this knowledge may make LIS trainers feel like they are giving up the secrets to their job security, and thus they are likely to be reluctant in sharing what they know (He et al., 2023). This would discourage knowledge sharing in the education industry because instructors who believed they could be rendered redundant would not share their expertise. As a result, people's unwillingness to share knowledge is a problem that must be addressed. For example, incentives should be provided to encourage educators to share their knowledge. Ehijiagbone and Olatokun (2020) discovered that the lack of necessary criteria such as rewards, incentives, organisational policy on tacit knowledge exchange, or an adequate environment are inhibitors for knowledge sharing. Salary increases, bonuses, job security, and other factors must, therefore, be considered as incentives (Fullwood et al, 2013).

Knowledge sharing remains challenging to implement in underdeveloped nations because it takes a favourable attitude to share knowledge voluntarily (Mazorodze and Mkhize, 2022). Since coercing instructors to share

knowledge is immoral, it is necessary to raise awareness of the importance of sharing knowledge so that LIS educators can respond positively. Despite the fact that Nigeria has more public and private universities, there is concern regarding professors' low performance in terms of teaching and research. This demonstrates that professors, who are at the forefront of knowledge acquisition, have yet to properly leverage the existing information sharing platforms to improve their competitive advantage. Poor workplace performance can be attributed to a variety of causes, including the LIS educators' unwillingness to share their experience with other members of the organisation, which may have a negative impact on performance. That is why this study sought to investigate the attitudes of LIS instructors regarding information sharing in South-west Nigerian universities.

Objectives of the Study

The main purpose of the study was to investigate LIS educators' attitude toward knowledge sharing practices of universities in South-west, Nigeria. The goals of the study were to specifically:

i. determine the knowledge sharing practices of LIS educators in universities in South-west Nigeria;

ii. examine the attitudes of LIS educators towards knowledge sharing practices in South-west, Nigeria

Research Questions

i. What are the knowledge sharing practices among LIS educators in universities in South-West, Nigeria?

ii. What are the attitudes of LIS educators towards knowledge sharing practices in South-west, Nigeria?

Literature Review

For LIS teachers, talking to each other about what they know is not just a nice idea; it is something they really need to do if they want to keep up with the way education is changing. When lecturers share ideas and experiences, they get to hear about new tools, fresh teaching methods, and better ways to help their students succeed. Research has shown just how powerful this can be. For instance, Olatokun et al. (2024) discovered that when LIS lecturers in Nigerian universities shared information, it influenced how they use

MOOCs (Massive Open Online Courses) which are fast becoming a modern way of teaching. In another example, Inyang (2022), in a study at the University of Calabar, talked about how mentoring and working together helps LIS teachers feel like they belong to a community and makes it easier for them to solve problems in their work.

Sharing knowledge helps lecturers stay informed, work better together, and keep their teaching methods fresh and relevant. However, it all comes down to attitude, how a person thinks, feels, and plans to act towards a person, group, activity, or idea. Attitudes can be good or bad. If the attitude is affirmative towards a deed, then it can be termed as positive. The Theory of Reasoned Action (TRA) is utilised to measure a person's attitude towards the knowledge sharing behaviour that, in turn, can affect the inclination of a person to share the knowledge. The TRA tells us how somebody's conduct is determined by their desire to do something (Ajzen & Fishbein, 1980). The theory tells us that intention is influenced by attitude towards an action andsubjective norm. ,

In terms of knowledge sharing, one's attitude and subjective norms drive intention to share. Knowledge sharing is very significant to educators and learners because it leads to new knowledge generation. Areekkuzhiyil (2019) researched the Kerala, India undergraduates and investigated the attitude towards knowledge sharing and reached the conclusion that there exists a positive attitude towards knowledge sharing among the students. A cross-sectional research design was adopted in the research, with a representative sample of 400 students belonging to different departments. The research concluded that there is positive attitude towards knowledge sharing. Likewise, the studies demonstrate that attitude towards knowledge sharing differed significantly by gender, study stream and institution type. Various studies place greater emphasis on the importance of knowledge sharing in education. A study by Xu and Li (2022) placed greater emphasis on how crucial knowledge sharing is for professional development and competitive edge among educational institutions.

Adu and Olowu (2022) focused on the promotion of acceptable norms for knowledge sharing in developing countries like Nigeria and the need for teaching practices that are relevant to the community. Onifade (2015) conducted another study on knowledge sharing among Nigerian federal universities, using a questionnaire to obtain data from 362 librarians. The

study found a positive attitude toward knowledge sharing. However, the practice of knowledge sharing among the library professionals was low. The knowledge being shared was mostly by word of mouth, workshop and seminar.

Awodoyin et al. (2016) also looked into librarians' knowledge-sharing practices in selected Nigerian academic libraries. Their study found that librarians may share knowledge through newsletters, mobile phones, face-to-face communication, and email, which improves emotional relief, efficiency, innovation and effectiveness. However, information exchange has not yet been formally implemented in the academic context investigated. It was suggested that information sharing become a routine that management of the studies library should implement.

Ehijiagbone and Olatokun (2020) investigated tacit knowledge-sharing (KS) practices of thirty-one purposively selected academics at the University of Ibadan in Nigeria. Using a case study research approach, the study investigated the availability of tacit knowledge sharing culture and practices, the factors influencing tacit knowledge sharing, and how the University facilitates the sharing of this type of knowledge. The study foundb that there is a widespread culture of information sharing among professors, and that they share tacit knowledge through personal encounters, conversations, and, most importantly, seminars. They identified communication, lecturers' willingness to share tacit knowledge, the presence of cordial relationships, the availability of constant electricity in offices and the university environment, and a platform for older lecturers to mentor younger ones as factors that positively influence their tacit knowledge sharing. The study revealed that there is little sharing of tacit knowledge among professors. The provision of a platform for sharing tacit knowledge, the inclusion of a reward system, and an enabling atmosphere were all advocated. According to Olatokun and Elueze's (2012) study findings, the level of information technology (IT) utilisation has a substantial influence on knowledge sharing behaviour. More IT infrastructure and services that promote beneficial knowledge sharing were advocated.

Methodology

Using a descriptive survey methodology, the population consisted of four hundred and eight Library and Information Science (LIS) educators from South-West Nigeria. The overall population included academic librarians and

academic personnel from Library and Information Science Departments at universities in South-West Nigeria. Library and Information Science Educators are university lecturers/educators who are in charge of training library personnel, as well as professionals who work in academic libraries and teach LIS-related courses at universities. A total enumeration technique was utilised to sample the entire population. The data collection instrument was a questionnaire, with 334 copies found usable with a response rate of 69.5%. Data analysis was done through descriptive statistics.

Results and Discussion of the Findings

The demographics of the respondents are presented in Table 1.

Table 1: Demographic characteristics of the Respondents

Demographic Variables		Frequency	Percentage
Gender	Female	181	54.2
	Male	153	45.8
	Total	**334**	**100**
Age Range			
	21 _30 years	63	18.9
	31_40 years	102	30.5
	41_50 years	103	30.8
	51_60 years	58	17.4
	Above 61 years	8	2.4
	Total	**334**	**100**
Qualification			
	PhD	92	27.6
	Masters	106	31.7
	Others	136	40.7
	Total	**334**	**100**

The results in Table 1 revealed 45.8% of the respondents were male while 54.2% were female. This indicates a higher proportion of female LIS Educators than their male counterparts in the surveyed universities. The results further revealed that most of the respondents were between ages 21-30years (18.9%) and 31-40 years (30.5%) while those above 60years were only 2.4%. This implies that majority of the respondents were active working age made up the majority of the respondents. The table also showed that the majority (59.3%) held a Masters degree while about 54% worked in the higher institution of learning for 1-10 years. This may imply that a higher percentage of respondents are early or mid-career LIS educators.

The results of the analysis based on the research questions are presented in Tables 2 and 3.

Table 2: Knowledge Sharing Practices among LIS Educators

Knowledge Sharing Practices	Strongly Disagree/Disagree	Strongly Agree/Agree	Mean	Std. Dev
I discuss about new knowledge formally with fellow colleagues	325(97.3%)	9(2.7%)	3.36	0.59
I use the internet to share new knowledge with other colleagues	318(95.2%)	16(4.8%)	3.35	0.58
I share new knowledge with others informally	306(91.6%)	28(8.4%)	3.32	0.65
I use the social media to share new knowledge	309(92.5%)	25(7.5%)	3.28	0.62
I share new knowledge through printed copies to other colleagues	286(85.6%)	48(14.4%)	3.18	0.72

According to the data in Table 2, respondents indicated knowledge-sharing activities among LIS educators. The findings revealed that having a formal discussion about new knowledge with co-workers has the greatest mean value (3.36). This is closely followed by LIS educators using the internet to share

new knowledge with other colleagues (mean = 3.35). However, of the other knowledge-sharing behaviours reported by the respondents, the distribution of printed copies of new knowledge to colleagues had the lowest mean value (3.18). The data showed that LIS teachers in the Nigerian region that was surveyed shared more information among themselves.

These findings on how LIS instructors share information relate closely to earlier studies by Howell and Annansingh (2013), Awodoyin et al. (2016), and Akosile and Olatokun (2020). For instance, consistent with the current study's observation that new knowledge is shared online and through technical means, Awodoyin et al. (2016) found that LIS professionals exchange information not only face-to-face but also via mobile phones, email, and newsletters. This multi-channel approach fosters innovation, improves efficiency and effectiveness, and supports emotional well-being, reinforcing the present study's conclusion about the value of technology in knowledge sharing among educators.

Similarly, Ehijiagbone and Olatokun (2020) stressed the importance of information sharing among lecturers, echoing this study's findings on the role of formal discussions in spreading new knowledge. Their research showed that LIS instructors effectively share tacit knowledge through personal interactions, conversations, and seminars, demonstrating the combined value of both formal and informal methods. Together, these studies highlighted how blending traditional and technology-driven approaches creates a more collaborative, innovative, and professionally enriching environment within the LIS field.

Table 3: LIS Educators' Attitude towards Knowledge Sharing

Attitude towards Knowledge Sharing	Strongly Disagree/Disagree	Strongly Agree/Agree	Mean	Std. Dev
I feel that I acquire new knowledge by sharing knowledge and experience	4(1.2%)	330(98.8%)	3.57	0.52
I feel that professional development is enhanced by sharing	5(1.5%)	329(98.5%)	3.52	0.56

knowledge in teaching and research				
I understand the importance of sharing knowledge in teaching and research	5(1.5%)	329(98.5%)	3.46	0.54
I feel that I save time when I share teaching materials with colleagues	25(7.5%)	309(92.5%)	3.33	0.69
I feel that sharing knowledge and transferring experience enhances social interaction	99(29.7%)	235(70.3%)	2.93	0.89

The results in Table 3 show that respondents felt sharing their knowledge and experiences helps them gain new insights (mean score: 3.57). They also agreed that exchanging knowledge in teaching and research plays a key role in their professional development (mean score: 3.52). Put simply, the LIS instructors surveyed clearly see information sharing as a positive and valuable practice.

Ajzen and Fishbein's (1975) work suggested that what people do is largely shaped by their intention to act, and that intention is influenced by how they feel about the activity itself. In other words, when someone has a positive attitude combined with social encouragement, they're more likely to follow through, which can lead to a better performance. In this study, the findings showed that LIS educators generally have a positive attitude towards sharing information, which means they're willing to take part in such practices. This aligns with earlier findings. For example, Onifade (2015) and Fayda-Kinik (2022) both found that educators tend to view information sharing favourably. Fayda-Kinik (2022) noted that faculty members were open and ready to share what they knew, while Quadri (2019) observed a similar pattern among LIS professionals in university libraries across South-west Nigeria. The trend is not unique to Nigeria. Abd-Mutalib et al. (2023) found that among Korean educators, a positive attitude towards information sharing went hand in hand

with a strong intention to share. Taken together, these studies pointed to the same conclusion: cultivating the right attitude towards knowledge sharing is a key step in boosting collaboration among LIS educators; and that collaboration is an important driver of professional growth.

Conclusion and Recommendations

For any educator who wants to grow in their career, publish stronger research, and stay relevant, sharing knowledge is key. The same goes for universities; they can't thrive or last without it. This study examined how Library and Information Science (LIS) lecturers in South-west Nigerian universities share what they know. Three main methods stood out: formal discussions, the use of ICT tools, and, less often, sharing printed materials. Formal discussions, whether in conferences, seminars, or presentations, remain a favourite. They give colleagues a chance to exchange ideas, learn from each other, and work as a team. Technology is also playing a big role. Many lecturers now share information online and use digital tools to make communication faster and access to knowledge easier. Printed hand-outs, however, are rare, probably because printing costs are high. One good sign is that most LIS educators actually want to share knowledge; they have a positive attitude towards it. The challenge is making it a consistent habit. To push this forward, the study suggested three things. First, educators should intentionally build a culture of sharing, which opens minds and strengthens collaboration. Second, universities should introduce rewards and incentives to encourage it, especially for younger lecturers. And third, NALISE (the National Association of Library and Information Science Educators) could champion a mentor–mentee system to pair experienced lecturers with newer ones. This would make sharing second nature and boost professional growth across the board.

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CHAPTER FIVE

Cross-Border Digital Education: Challenges and Opportunities for Universal Learning Access

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Abstract

Cross-border digital education offers immense potential to expand global learning access, yet it is challenged by technological inequalities, digital literacy gaps, language barriers, and inconsistent regulatory frameworks. This study adopted a secondary data-based approach, drawing insights from existing reports and academic literature to examine how digital education can support inclusive and universal learning. The analysis highlighted critical obstacles such as inadequate infrastructure, limited affordability, and linguistic inaccessibility that continue to exclude marginalised learners. However, it also identified emerging opportunities, including the use of AI-driven learning platforms and international policy cooperation, to create more inclusive educational ecosystems. The study concluded that while digital tools can enhance educational outreach across borders, targeted reforms and scalable frameworks are necessary to ensure equity and sustainability. The study emphasised designing adaptable, culturally sensitive models that prioritise both access and quality to bridge the digital divide and enable lifelong learning for diverse populations globally.

Keywords: Cross-border, Digital Literacy, Education, Global Learning.

Introduction

In an increasingly globalised and digitally interconnected world, education is undergoing a profound transformation. The rise of cross-border digital education, defined as the provision of learning experiences across national boundaries via digital technologies, has introduced new paradigms of accessibility, scalability, and inclusiveness. While traditional education has long been bound by geographical, economic, and political constraints, digital modalities are beginning to transcend those limitations, offering unprecedented access to knowledge and skills for learners worldwide.

However, this transformation is neither linear nor universal. The very technologies that promise democratised learning often reinforce existing inequalities, particularly when cross-border implementation encounters disparities in infrastructure, policy, and digital literacy.

Global trends in online education reflect both optimism and complexity. According to Altbach and de Wit (2018), the internationalisation of higher education is increasingly being shaped by digital delivery models, with Massive Open Online Courses (MOOCs), hybrid programmes, and virtual exchange initiatives gaining traction across regions. The aspiration to provide equitable access to learning opportunities, regardless of geography, is echoed in the United Nations' Sustainable Development Goal 4 (SDG 4), which emphasises inclusive and equitable quality education for all. However, fulfilling this vision requires not only technological intervention, but also deep structural changes, particularly in how educational content is designed, delivered, regulated, and localised.

Recent academic literature has critically evaluated both the opportunities and limitations of cross-border digital education. For instance, Knight and McNamara (2017) argued that although cross-border e-learning programmes hold potential to expand access in low-income countries, they often reproduce neo-colonial knowledge hierarchies by privileging content and pedagogy from the Global North. This imbalance raises concerns about cultural homogenisation and the devaluation of indigenous learning systems. In contrast, Wang, Wang, and Shee (2020), through a study of international e-learning adoption in Southeast Asia, found that learner engagement and retention improved when digital platforms were localised both linguistically and culturally. This suggests that meaningful cross-border education must be both globally accessible and locally relevant.

Yet, even with promising models, several enduring challenges persist. Technological infrastructure is perhaps the most visible barrier. While countries such as South Korea and Estonia have achieved near-universal internet access, large swathes of Sub-Saharan Africa and South Asia still struggle with unreliable connectivity and digital device shortages (ITU, 2023). This disparity reinforces a digital divide that limits educational participation across borders, particularly among historically marginalised groups such as rural learners, women, and persons with disabilities. Moreover, lack of

institutional interoperability, where qualifications, assessments, and learning credentials are not recognised across national borders, creates further friction in the mobility and utility of cross-border digital education (Chakroun & Keevy, 2018).

Regulatory misalignment poses another critical issue. Unlike physical universities operating within well-defined national frameworks, digital education providers often navigate a fragmented policy landscape where intellectual property rights, data privacy laws, and quality assurance standards vary significantly. For instance, while the European Higher Education Area (EHEA) has taken coordinated steps to ensure cross-national credit recognition through the Bologna Process, similar mechanisms are largely absent in Africa, Latin America, and parts of Asia (Marginson, 2020). These discrepancies hinder the portability and legitimacy of digital learning credentials, undermining their value in transnational labour markets.

Despite these challenges, innovative solutions continue to emerge. AI-enabled learning systems, blockchain-based credentialing, and multilingual learning platforms have been heralded as breakthroughs in making digital education more personalised, secure, and inclusive. For example, UNESCO (2022a) highlights the use of AI to create adaptive learning environments that cater to individual learners' pace and style, particularly in multilingual or under-resourced contexts. Moreover, collaborative initiatives like the African Virtual University (AVU) and India's SWAYAM have demonstrated scalable models that blend public policy with open-access technologies to expand cross-border learning access in the Global South.

It is important, however, to recognise that technological innovations cannot succeed in isolation. Cultural sensitivities, ethical concerns, and institutional buy-in are equally critical to the sustainability of cross-border digital education. As Singh and Elahi (2021) noted, the success of global e-learning platforms depends not only on bandwidth and algorithms, but also on pedagogical trust, learner autonomy, and the mutual recognition of academic standards. The notion of "universal access" must thus be reinterpreted—not as a one-size-fits-all solution, but as a pluralistic ecosystem where digital pathways are tailored to the diverse needs, constraints, and aspirations of learners around the world.

This research paper sought to examine these dynamics with greater granularity. While most existing studies focused either on the technological aspects or the policy frameworks of cross-border education, few explored how these dimensions interact with one another to either facilitate or hinder universal access. Through a critical review of secondary sources, this study aimed at unpacking the multidimensional challenges, ranging from infrastructure and digital literacy to governance and equity, and the parallel opportunities arising from AI tools, multilingual platforms, and global collaborations. Ultimately, this inquiry did not approach digital education as a neutral or inevitable evolution, but as a contested space where power, access, and innovation are in constant negotiation. The central question, therefore, is not just how to expand digital learning across borders, but how to do so in ways that is equitable, culturally inclusive, and contextually sustainable. Addressing this question requires a nuanced understanding of both systemic constraints and emergent possibilities—a balance this paper aimed to strike.

Review of Literature

Theoretical and Policy Foundations

The foundational moment for cross-border digital education can be traced to UNESCO's 2015 Qingdao Declaration**,** which called for harnessing ICT to ensure inclusive education, and, therefore, proposed frameworks for global credential recognition (UNESCO, 2015). This policy's emphasis laid groundwork for emerging research on transnational educational frameworks. Knight and McNamara (2017), writing in *Higher Education Quarterly*, explored quality assurance across international online programmes, highlighting significant disparities in accreditation standards and cautioning against assuming that digital delivery alone ensures academic legitimacy. Similarly, Marginson (2018), in *Studies in Higher Education,* emphasised that the credibility of cross-border qualifications depends not merely on technology adoption, but also on robust institutional coordination, policy coherence, and mutual trust.

Access and Infrastructure Disparities

Reliable infrastructure remains a persistent barrier to universal access. Reddy, Jose, and Vaidehi (2021) documented that learners in remote regions often contend with intermittent internet, outdated devices, and high data costs, which significantly undercut the democratising potential of online education.

These findings echoed those from the OECD (2023), which revealed that while broadband penetration is rising globally, rural and marginalised communities lag behind. The OECD (2023) strongly advocates embedding Universal Design for Learning (UDL) principles, ensuring that digital tools offer accessibility through flexible interfaces and multimodal content delivery. These technological and access-oriented frameworks, however, cannot stand alone; they must be complemented by social and institutional supports that recognise and adapt to learners' constraints.

Pedagogical Design and Learner Trust (2018–2022)

Access without quality can exacerbate educational inequities. Lund, Harrison, and Gemmell's (2025) study in *Education and Information Technologies* emphasised the complexity of developing cross-border digital courses that are both rigorous and responsive to diverse learner needs. Their interviews with international graduate students uncovered challenges related to clarity of expectations, cultural assumptions embedded in learning tasks, and the absence of community support—all factors that diminished learner trust and engagement. Complementing this, Hennessy (2021), in *Comparative Education,* demonstrated that teacher readiness, defined by cultural competence and digital pedagogy, served as a critical moderator in whether students engaged meaningfully with digital content. Without culturally attuned pedagogy, digital education can feel foreign and isolating to learners outside its dominant context.

MOOCs, Micro-credentials, and Modular Learning

MOOCs marked a widely discussed early model for scalable, cross-border education. Asyhari and Islamia (2023) compared self-regulation and motivational outcomes among Indonesian students engaging with MOOCs versus traditional classrooms, finding similar levels of self-regulated learning but consistently higher intrinsic motivation within face-to-face environments. This pattern suggests that while MOOCs enhance access, they may lack motivational structures inherent to in-person communities. On a related front, UNESCO (2022b) spotlighted micro-credentials as a flexible means to certify discrete skills globally. Yet, a 2023 thematic review (Springer, 2023) highlighted fragmentation in validation mechanisms, noting that learners often navigate inconsistent accreditation landscapes with patchy recognition across sectors. MOOCs and micro-credentials hold considerable promise, but their

potential remains limited unless ecosystems of trust and standardisation are built across borders.

Cultural, Linguistic, and Contextual Adaptation

Cross-border digital education must engage meaningfully with local contexts. Mays et al. (2022), in their comparative study of remote teaching in Sub-Saharan Africa, cautioned against importing standard English-medium curricula without adaptation, noting how such practices can marginalise local knowledge traditions and reduce learner motivation. Similarly, Pérez and Lee (2023), in *International Review of Research in Open and Distributed Learning*, reported that bilingual course delivery significantly improved learner engagement in Latin America and Southeast Asia, yet most digital platforms remain monolingual—rooted in global English norms. These studies underscored the importance of culturally responsive curriculum design and the privileging of local epistemologies alongside global perspectives.

Equity, Inclusion, and the Digital Divide (2020–2025)

The COVID-19 pandemic brought digital inequities into sharper relief. A large-scale review by Johnson and Turner (2021) found that participation among students from low-income households plummeted by 30–40% when education shifted online. Equally, digital literacy issues emerged not just from access gaps but from unfamiliarity with online learning environments, reducing both participation and academic outcomes (Liang et al., 2022). UNESCO's 2023 report on digital inclusion emphasised that equitable access strategy must encompass device provision, connectivity, digital skills training, and ongoing technical and emotional learner support.

Emerging Technologies: AI, Immersive Learning & Governance (2021–2025)

Innovations like AI, virtual reality (VR), and the metaverse hold transformative potential. Nwadinachi and Ivanov (2022), in *Computers & Education*, surveyed AI applications in cross-border programmes and found enhanced personalisation but raised concerns over algorithmic transparency, data privacy, and uneven infrastructure between regions. VatandoustMohammadieh et al. (2024) proposed an AI-driven scaffolding framework aiming to support diverse learners at scale; yet they admitted that real-world pilots remain limited and largely confined to high-resource

contexts. Additionally, Jagatheesaperumal et al. (2022) warned that immersive technologies might exoticise rather than engage global learners if cultural localisation is sidelined. Though promising, these advanced technologies risk replicating access inequities unless carefully guided by ethical, culturally sensitive strategies.

The corpus of literature from 2015 to mid-2025 paints a landscape of ambitious potential entwined with persistent structural challenges. Although access continues to expand through digital networks and platforms, the inequities of infrastructure, cultural misalignment, limited accreditation frameworks, and underdeveloped technological governance undermine the realisation of universal learning. A pressing need exists for integrative, cross-contextual frameworks and empirically validated interventions that are not only digitally accessible, but also pedagogically rich, culturally resonant, and institutionally credible.

Research Gaps

Despite significant advancements in digital learning technologies and a growing global emphasis on equitable access, several critical research gaps persist in the domain of cross-border digital education. First, while numerous studies have explored digital infrastructure disparities (Reddy et al., 2021; OECD, 2023), there is limited work on how infrastructure interacts with pedagogical models and digital literacy in cross-border settings. Most discussions isolate access from actual learning experiences, overlooking how technology, pedagogy, and learner capability influence one another.

Second, existing research often highlights cultural and linguistic barriers (Mays et al., 2022; Pérez & Lee, 2023), but few studies have evaluated scalable frameworks for integrating local content or languages into global digital platforms. Localisation remains superficial in most global e-learning programmes, lacking depth in cultural relevance and epistemological inclusion. Third, while micro-credentials and MOOCs are widely studied (Asyhari & Islamia, 2023), their regulatory acceptance across borders is inconsistent. There's a clear gap in comparative research that evaluates how digital qualifications are recognised (or rejected) by educational and labour market institutions in different countries. Although emerging technologies like AI and VR are hailed as potential equalisers (VatandoustMohammadieh et al., 2024; Nwadinachi & Ivanov, 2022), little is known about their actual

application in low-resource or multilingual environments. Many models remain theoretical or are piloted only in high-income countries.

A key gap remains in developing an integrated understanding of how cross-border digital education can be made both inclusive and scalable, while ensuring pedagogical effectiveness, cultural relevance, and alignment with diverse policy frameworks.

Research Objectives

Based on the identified gaps, the objectives of this study were to:

1. investigate the key barriers—technological, economic, linguistic, and regulatory—that limit equitable access to cross-border digital education;
2. explore the role of AI-driven technologies and international policy collaboration in creating scalable models for inclusive digital learning across borders; and
3. critically analyse existing secondary data and scholarly literature to identify effective strategies and policy frameworks that can bridge the global digital divide in education.

Methodology

This study adopted a qualitative, exploratory research methodology grounded in the analysis of secondary data. Given the global and complex nature of cross-border digital education, this approach is appropriate for synthesising insights across diverse geographical, technological, and policy contexts. The study drew on a wide range of scholarly articles, policy papers, and institutional reports published between 2015 and 2025 in reputed journals and platforms such as SCOPUS, Springer, ABDC, and UNESCO. A purposive sampling strategy was employed to select literature relevant to the themes of digital accessibility, cross-border learning, and equity in education. The collected data were analysed thematically, identifying recurring patterns and gaps in areas such as infrastructure, digital literacy, regulatory frameworks, and technological innovations like AI. This method allowed for a nuanced understanding of how challenges and opportunities intersect in digital education across borders; and it provided a solid foundation for proposing scalable and inclusive models for universal learning access.

Data Analysis

Cross-border digital education occupies a paradoxical space—at once aspirational and fragmented. With a large and growing population of school-aged learners and an expanding higher education landscape, some regions are uniquely positioned to benefit from the opportunities presented by global digital education initiatives. Yet, disparities in digital access, linguistic diversity, regulatory rigidity, and infrastructural inequality continue to hinder its realisation of universal, borderless learning.

Infrastructural Asymmetry: The Uneven Geography of Access

At the core of the challenges surrounding cross-border digital education lies a persistent digital infrastructure gap. While urban areas in many regions are witnessing improved internet access and technology adoption, rural and remote communities often remain under-connected. This divide is more than a matter of connectivity—it reflects deeper patterns of educational exclusion shaped by geography, language, socio-economic status, and institutional reach. Although private digital learning platforms have accelerated the spread of online educational content, their access remains uneven, often favouring urban, tech-savvy, and linguistically privileged groups. The disparity becomes even more evident in border or hard-to-reach regions, where basic digital infrastructure, such as broadband, electricity, and reliable hardware, is inconsistent or entirely lacking. Efforts to expand digital education through policy and public infrastructure initiatives face challenges in last-mile implementation. While mobile internet access has improved in many places, affordability and accessibility do not always translate into meaningful educational experiences. Learning on small, low-end devices often shared among multiple users can limit engagement, especially with global courses that require real-time interaction, sustained connectivity, and adequate processing capacity. In such contexts, students are not simply underserved; they are structurally excluded from the digital learning revolution.

Digital Literacy: A Fragmented Terrain of Skills and Assumptions

Beyond infrastructure, digital literacy emerges as a critical yet often misunderstood barrier to equitable digital education. The popular belief that younger generations are naturally proficient with technology does not always hold true upon closer inspection. Familiarity with social media, entertainment platforms, or basic device usage does not necessarily translate into the skills

required for academic engagement in digital environments. The ability to navigate online learning platforms, manage digital assignments, or participate meaningfully in virtual classrooms often requires a very different set of competencies. This challenge becomes even more complex in multilingual societies, where the dominance of a single global language—often English—on cross-border education platforms creates an invisible barrier for many learners. Those who are not fluent in the language of instruction, especially women, first-generation learners, or individuals from underrepresented linguistic backgrounds, often find themselves excluded from meaningful participation.

Even where open online courses exist to expand access, limited localisation of content and inadequate learner support can undermine their effectiveness. Without attention to regional languages, culturally relevant materials, and inclusive pedagogical approaches, such platforms risk reinforcing educational divides rather than bridging them. The promise of democratising education through digital means is compromised when language, literacy, and learner context are overlooked- transforming a tool of empowerment into yet another gatekeeper of opportunity.

Regulatory Fragmentation and Credential Incompatibility

The regulatory landscape for digital education in many regions remains fragmented and lacks the coherence needed to support international recognition of online credentials. While some national authorities have begun approving fully online degree programmes and a few cross-border collaborations with renowned global universities have emerged, these efforts are often isolated rather than part of a coordinated strategy. Credentials earned through online platforms—such as MOOCs or micro-certifications—frequently face challenges in being recognised by employers or academic institutions, particularly when not associated with high-profile international brands. Conversely, qualifications awarded by domestic digital education providers often encounter skepticism abroad, largely due to concerns over quality assurance and standardisation. This lack of mutual recognition limits the mobility of learners and the transferability of skills across borders. A student may acquire valuable competencies through an online global course, but whether those skills are accepted for employment or further education in another country remains uncertain. Further complicating the issue, many

academic institutions remain cautious in forming cross-border digital partnerships. Barriers include bureaucratic processes, inflexible accreditation systems, and concerns over curricular autonomy. As a result, international collaborations in digital education are frequently more symbolic than strategic, lacking in depth, scale, or sustained impact. Without aligned policies to support learning equivalency, quality benchmarks, and reciprocal credit transfer mechanisms, the vision of seamless cross-border digital education remains difficult to realise.

Emergence of AI-Driven Opportunities and Adaptive Models

Despite ongoing challenges, there are promising signs of innovation in the digital education landscape. AI-powered educational technologies are beginning to offer more personalised and inclusive learning experiences. Some platforms now leverage Artificial Intelligence to respond to individual learner queries with customised explanations in local languages, while others use adaptive learning techniques to tailor content, offer career guidance, and assess skills based on user profiles. These emerging tools signal a potential shift in approach: instead of requiring learners to conform to rigid, standardised global content, technology can be harnessed to adapt that content to individual needs and contexts. When integrated with localised data, AI systems can predict dropout risks, suggest relevant learning resources, and adjust instructional pacing in real time to improve engagement and outcomes.

However, such innovations remain at a relatively early stage and are often developed in isolation, without meaningful integration into national education systems or public policy frameworks. Most current deployments are led by private ventures with commercial objectives, and this limits their reach and scalability. Without well-structured public-private collaborations, the transformative potential of these technologies risks being confined to those with the means to access them, rather than serving as inclusive solutions capable of reshaping education systems at scale.

Cultural Dissonance and the Politics of Knowledge

One of the more subtle yet deeply impactful barriers to cross-border digital education lies in the politics of knowledge itself. Many global learning platforms are shaped by dominant pedagogical traditions, case studies, and epistemologies that often reflect Western or Eurocentric worldviews. This can create a sense of cultural dissonance for learners in other parts of the world,

where the curriculum may feel distant from local contexts and realities. For example, a student studying marketing might encounter case studies centred on global financial hubs, with limited relevance to their own economic environment. This disconnect can lead to disengagement and the perception that global knowledge is foreign, elite, or inaccessible.

Moreover, there remains a lack of meaningful participation from diverse educational communities in the co-creation of content on international platforms. While educators from various backgrounds may contribute to global courses, their perspectives are often not grounded in local languages, regional examples, or culturally relevant case material. This imbalance affects not only cultural representation but also comprehension and practical applicability. In addition, social structures, such as those shaped by religion, gender norms, or other identity, based hierarchies, continue to influence access to digital education in ways that are often overlooked. Factors like access to personal devices, family support for online learning, and opportunities for internships or global exchanges are frequently mediated by these deeper societal dynamics. Analyses that ignore such forces risk offering an incomplete or overly sanitised view of educational access and inclusion. For digital education to be truly equitable and global, it must engage with these contextual realities—both in content and in delivery.

Institutional Readiness and Pedagogical Innovation

Indian higher education institutions, particularly public universities, are at varying levels of readiness to embrace cross-border digital models. The National Education Policy (NEP) (2020) has opened new pathways for online degrees and international collaborations, but implementation remains uneven. Faculty development in digital pedagogy is limited, and most teachers still rely on lecture-heavy formats that do not translate well into online delivery. There are encouraging exceptions where cross-border digital education programmes have demonstrated positive outcomes, particularly when supported by interactive features such as peer discussion forums, local facilitators, and blended assessment methods. These initiatives show that when thoughtfully designed, digital education can foster engagement and learning across diverse contexts. However, such examples remain isolated rather than widespread. Without broader investments in pedagogical training,

curriculum redesign, and institutional support systems, the momentum of digital learning will remain fragile and uneven.

To ensure lasting impact, international collaborations in digital education must evolve beyond symbolic agreements or memoranda of understanding. What are needed are deeper, reciprocal partnerships that include joint curriculum development, dual degree pathways, and co-teaching arrangements. These approaches can enhance both the quality and relevance of educational content, while fostering greater trust and cooperation between institutions across borders.

Findings and Interpretation

The investigation into cross-border digital education using data analysis yields a number of critical findings. These findings, though rooted in secondary data, are analysed with the lens of the study's core objectives: identifying barriers, exploring enablers, and interpreting the potential of policy-tech collaborations to bridge digital inequities in education. Rather than isolating variables, the analysis emphasises relational insights—how structural, technological, cultural, and institutional dimensions intersect.

The Illusion of Digital Ubiquity

Contrary to popular narratives of a global leap into a digital education era, the reality on the ground remains uneven and fragmented. While there are high numbers of internet users and growing smartphone penetration, it often obscures significant disparities in meaningful digital access. The findings suggest that having a device or an internet connection does not automatically translate into inclusive or effective educational experiences. For learners in low-income, rural, or linguistically marginalised communities, access is frequently limited, shared among multiple users, and subject to instability. This highlights that the so-called "digital access revolution" is often overstated in structural terms and underwhelming in pedagogical impact. When educational technologies operate in isolation—without adequate institutional support, training, or localised relevance—they risk becoming symbolic rather than transformative. These insights align with the concerns raised by Reddy et al. (2021) and OECD (2023), emphasising that access alone does not guarantee engagement or equitable learning outcomes.

Language and Literacy as Invisible Barriers

A significant and often underexplored insight is the depth of language as a gatekeeper in cross-border digital education. While India boasts over 20 official languages and hundreds of dialects, most global digital education platforms, including MOOCs and AI-driven tools, operate almost exclusively in English. The mismatch is not only linguistic but epistemological. The study found that learners often struggle not because they lack intelligence or motivation, but because the design of content assumes cultural fluency in academic norms. This linguistic dominance marginalises regional learners and often erodes self-confidence. Interpretation suggests that without sustained investment in multilingual content, interface localisation, and culturally relevant case examples, cross-border education will remain exclusionary. Even national platforms like SWAYAM, NPTEL etc., which offer some courses in Hindi and regional languages, fall short of addressing this complexity. Translation is not equivalent to localisation. Mere linguistic conversion cannot substitute for pedagogical redesign that aligns with learners' social realities and cognitive schemas.

Pedagogical Incongruence in Cross-border Offerings

One of the more nuanced findings is that global digital education models often reflect pedagogical assumptions alien to Indian learners and educators. For instance, asynchronous, self-paced modules assume a high degree of learner autonomy and digital navigation skills—attributes more commonly found in high-resource, individualised education systems. In contrast, Indian learners are more familiar with hierarchical, instructor-led, exam-oriented systems. As a result, the design of global online programmes often mismatches with learners' educational conditioning, leading to cognitive overload, dropout, or disengagement. Interpreting this, we arrive at a critical contradiction: while technology enables borderless access, pedagogy often enforces new, invisible borders. Without rethinking instructional design for cross-border contexts, especially in developing nations, digital education may replicate the very exclusions it seeks to overcome.

Fragmented Regulatory Ecosystem and Weak Credential Portability

The study found that higher education system lacks a coherent framework for integrating international digital credentials. UGC regulations allow online degree delivery, but recognition of foreign MOOCs, micro-credentials, or

short-term digital courses is still ambiguous. This has two implications. First, learners taking cross-border digital courses may not gain formal academic or employment credit for their efforts. Second, digital degrees may face skepticism abroad, especially in those nations with more centralised quality assurance mechanisms. This regulatory mismatch creates a hidden cost of participation. Learners invest time and resources into programmes whose utility remains uncertain. The interpretation here is that cross-border digital education cannot scale meaningfully without synchronised accreditation systems that establish mutual trust, reciprocity, and standardisation. The findings supported calls by Knight and McNamara (2017) and Marginson (2018) for greater harmonisation in global higher education policy.

Potential of AI, But Unresolved Ethical and Access Questions

The major insight concerns the promise, and pitfalls, of AI-driven personalisation. Tools like adaptive assessments, chatbots, and automated feedback engines offer real-time learner support at scale. In theory, this could mitigate teacher shortages, enable multilingual interfaces, and detect dropout risks early. However, the most AI applications in digital education are driven by private sector innovations, disconnected from public education systems and absent from policy frameworks. The absence of regulation around algorithmic fairness, data privacy, and local language adaptation raises red flags. Interpretation suggests that while AI offers immense potential, its success depends on its integration into inclusive public infrastructures. Without that, it may reinforce the divide between elite learners who can afford intelligent tutors and the masses who receive static, impersonal content.

Conclusion

The evolution of digital education has opened unprecedented opportunities for learners to access knowledge beyond borders. With the rapid expansion of digital infrastructure, international academic partnerships, and virtual learning platforms, cross-border education is no longer a distant dream - it is a living reality. However, this transformation is far from complete or evenly distributed. While the surface shows promise, a deeper examination reveals enduring gaps that challenge the vision of truly universal learning access. Digital education, by design, aims to dissolve geographical boundaries and democratise knowledge. Yet, in practice, the benefits often remain concentrated among populations that already have access to stable internet,

digital literacy, and institutional support. Many learners, particularly in low-income, rural, or marginalised communities, face persistent barriers, such as lack of connectivity, high costs of digital devices, limited language options, and rigid academic systems that fail to recognise alternative learning credentials. These issues highlight the stark difference between technological availability and meaningful educational inclusion. Moreover, the current structure of cross-border digital learning often centres on one-size-fits-all approach, where content delivery is prioritised over cultural understanding and contextual relevance. Educational models, learning materials, and evaluation methods are frequently shaped by dominant academic systems, leaving little room for local knowledge, languages, or culturally specific learning needs. This asymmetry not only limits learner engagement, but also questions the authenticity and fairness of knowledge transfer across global contexts.

For cross-border digital education to evolve into a more just and impactful system, it must embrace a broader, more human-centric philosophy. It is no longer sufficient to focus solely on platforms, content, or scalability. The future demands education systems that are empathetic, inclusive, and adaptable. This includes the need for pedagogy that respects diverse learning styles, support systems that bridge digital divides and credentialing mechanisms that ensure global recognition and mobility for all learners. In this new educational paradigm, linguistic inclusivity must take centre stage. Many learners are excluded not because of lack of ability, but because the language of instruction remains unfamiliar. Integrating multilingual content and translation tools is vital to lowering this invisible barrier. Similarly, culturally responsive teaching should become the norm—not the exception—so that learners feel seen, valued, and understood within digital classrooms that span continents.

Equally important is the recognition and portability of digital learning credentials. Without frameworks for mutual recognition, the promise of online education loses its practical value. Learners must be assured that the time and effort they invest in digital learning will be accepted and respected across institutions, industries, and borders. In short, the journey toward inclusive cross-border digital education is not merely a technological challenge, but a deeply philosophical one. It calls for global collaboration, policy innovation, and a willingness to listen to the voices of learners from all walks of life. By

shifting our focus from access alone to access with equity, empathy, and cultural awareness, we can begin to build a digital education ecosystem that is truly transformative and genuinely global.

Future Implications

Looking forward, this research highlighted several critical directions:

1. **Localised Innovation**: AI and digital platforms must be re-engineered for multilingual, low-resource environments. Public-private partnerships should focus on inclusive design rather than tech branding.
2. **Policy Synchronisation**: Regulatory bodies must work with other counterparts to establish frameworks for credit transfer, recognition, and shared quality assurance.
3. **Cultural Collaboration**: Cross-border programmes should prioritise co-creation with Indian educators and learners, embedding local knowledge systems and regional realities into global curricula.
4. **Inclusive Infrastructure**: Investment must move from broadband expansion to whole-ecosystem support—device access, digital literacy training, emotional well-being, and peer networks.
5. **Longitudinal Research**: Other empirical studies can be done to track learner's journey across digital borders—what helps them thrive, what causes dropout, and what enables transformation.

Limitations of This Research

While this study has presented a detailed thematic analysis using high-quality secondary sources, several limitations are acknowledged. First, the absence of primary field data means the study is interpretive rather than statistically validated. Second, the focus on a country may limit universality, though it provides a rich case of both opportunities and constraints. Third, the pace of technological change means that findings, especially related to AI, may rapidly evolve. Finally, while this paper emphasised inclusivity and equity, the intersectional analysis (e.g., caste, gender, disability) could be explored in greater depth in future studies.

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CHAPTER SIX

International Partnerships and Collaborations: University of Ilorin Strategies

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Abstract

This study examined the role of international partnerships and collaborations at the University of Ilorin, focusing on their multifaceted significance in enhancing academic quality, fostering research innovation, and promoting global engagement. The research sought to illuminate how these collaborations contribute to a more dynamic and enriched educational environment. International partnerships facilitate the exchange of ideas, knowledge, and best practices, which not only elevate the quality of academic programmes but also enable faculty and students to engage in cutting-edge research initiatives. Through a qualitative analysis of existing partnerships with foreign institutions, this research identified the various dimensions of collaboration, including student and faculty exchanges, joint research initiatives, and curriculum development. This study employed a qualitative research approach to investigate the international partnerships and collaborations at the University of Ilorin. , The findings revealed that these partnerships not only broaden the educational experience for students but also foster a culture of academic excellence and innovation within the university. Furthermore, the study identified the challenges and opportunities associated with these international collaborations such as funding constraints and cultural differences. With a critical insight into the University of Ilorin's strategic approach to global partnerships, this research contributed to a deeper understanding of how such collaborations can positively influence higher education in Nigeria. The study underscored the importance of establishing robust international links to prepare students for a globalised workforce and to enhance the university's reputation on the international stage.

Keywords: Partnership, Collaboration, University of Ilorin, Strategies

Introduction

In an increasingly globalised world, internationalisation of universities has become a strategic imperative for higher education institutions seeking to enhance their academic reputation, foster research collaborations, and provide students with a global perspective. One effective approach to achieve this is through partnerships and inter-university linkages. These collaborations enable universities to share resources, expertise, and experiences, creating mutually beneficial opportunities for academic and cultural exchange. Unilorin is a university that has engaged in internationalisation of its campus and programmes right from its establishment in 1975. The drive was consciously pursued since 2009 with the creation of the Centre for International Education (CIE) in the university. The aim of this study, therefore, is to examine the effectiveness of common tools and strategies of intenationalisation in university education, using Unilorin as a case study. Descriptive and historical methods were adopted for the study.

This study examined specific partnerships and inter-university linkages that Unilorin has established, highlighting their impact on the university's internationalisation efforts. It explored the strategies employed by Unilorin to forge successful collaborations, the outcomes achieved, and the lessons learned along the way.

Importance of Partnerships and Inter-University Linkages

Partnerships and inter-university linkages play a crucial role in the development and progress of higher education institutions. Collaborations foster an environment of mutual learning, growth, and knowledge exchange. On this note, we explored the importance of partnerships and inter-university linkages in the context of higher education with the following:

Enhanced Academic Opportunities

This refers to the expanded and enriched learning experiences that staff and students can gain through partnerships and inter-university linkages (Mario Jose, 2017). These opportunities go beyond the traditional classroom setting and provide staff and students with additional avenues for academic growth and development. Through partnerships and collaborations between universities, they can access a wider range of academic resources, expertise, and facilities. This can include shared libraries, research centers, laboratories,

and specialised equipment that may not be available at their home institution. These enhanced resources allow them to engage in more comprehensive and in-depth research, experimentation, and learning.

Furthermore, partnerships and inter-university linkages often facilitate the exchange of students and faculty members between institutions. This allows them to study abroad or attend courses and seminars at partner universities. Such exchanges expose them to different teaching styles, perspectives, and cultural experiences, broadening their horizons and enhancing their overall academic experience. It also promotes interdisciplinary collaboration. By bringing together students and faculty members from different disciplines and institutions, these collaborations foster the exchange of ideas, knowledge, and expertise across various fields. This interdisciplinary approach encourages innovation, creativity, and problem-solving skills, preparing students to tackle complex real-world challenges.

Moreover, enhanced academic opportunities through partnerships can also lead to joint research projects, conferences, and academic events. These collaborative initiatives provide platforms for networking, knowledge-sharing, and professional development. Students can interact with experts, scholars, and professionals from different institutions, expanding their academic and professional networks.

Research Collaboration

Research collaboration, according to Sergio Manrique (2018), is a fundamental aspect of scientific progress, enabling researchers to pool their expertise, resources and insights to address complex research questions and achieve breakthrough discoveries. Collaboration in research involves individuals or teams from different disciplines, institutions, or even countries working together on a shared research project or objective. Collaborative research offers numerous benefits. It fosters knowledge exchange, promotes a multidisciplinary approach, and enhances the quality and impact of research outcomes. By bringing together researchers with diverse backgrounds and perspectives, collaboration expands the scope of investigation, encourages innovative thinking, and increases the likelihood of addressing complex problems comprehensively. Another key advantages of research collaboration is the ability to leverage complementary skills and resources. Each collaborator can contribute unique expertise, methodologies, and technologies,

leading to more robust study design, data collection, and analysis. This synergy often leads to novel insights, accelerated progress, and greater research output. Research collaboration is not limited to a specific field or discipline. It can occur within scientific communities, academia, industry, and even across borders. In recent years, the rise of digital communication platforms and collaborative tools has further facilitated global research collaboration, breaking down geographical barriers and enabling real-time collaboration on shared projects. Several studies have highlighted the positive impact of research collaboration. A research paper by Wuchty, Jones, and Uzzi (2007) analysed over 19.9 million scientific articles and found that highly collaborative research papers tend to receive more citations, indicating their higher impact and visibility within the scientific community. Another study by Kingsley ., Henning, ., & Tollefson, . (2017) emphasised the positive correlation between collaboration and scientific productivity, demonstrating that greater collaboration leads to increased research output.

Cultural Exchange and Diversity

Cultural exchange refers to the interaction and sharing of ideas, values, customs, and artistic expressions between different cultures. It occurs through various means such as trade, migration, travel, and technological advancements. This exchange often leads to the enrichment and diversification of societies, as it fosters the blending and integration of different cultural elements (UNESCO, 2005). The resulting cultural diversity creates a vibrant tapestry of traditions, languages, arts, and beliefs. One of the notable outcomes of cultural exchange is the emergence of hybrid cultures, where elements from different cultures merge to form something new and unique. This blending of cultural influences can be seen in various aspects of human life, including language, cuisine, fashion, music, and visual arts (García Canclini, N. 1995). Cultural exchange also has a profound impact on literature and the arts. It allows for the exploration of different perspectives, narratives, and styles, broadening the horizons of creativity. When writers and artists are exposed to diverse cultures, they gain new insights and inspiration, which often find expression in their works. This cross-pollination of ideas and artistic techniques can lead to the birth of innovative literary movements and genres. Moreover, cultural diversity in literature promotes inclusivity and representation. It provides a platform for marginalised voices, allowing them to share their stories and experiences. Through diverse literary works, readers

gain a deeper understanding of different cultures, breaking down stereotypes and fostering empathy. This not only enriches the literary landscape but also contributes to building a more inclusive and tolerant society. Cultural exchange makes a university a truly globalised environment.

Resource Sharing and Capacity Building:

Collaborative partnerships enable universities to pool their resources and expertise, leading to cost-sharing and efficient utilisation of available facilities. Through joint initiatives, universities can share libraries, laboratories, and other infrastructure, thus expanding the range of resources accessible to students and researchers. Furthermore, universities can leverage each other's strengths to build capacity in areas where they may have limitations, thus enhancing overall institutional capabilities.

Promoting Student and Faculty Mobility

In today's interconnected world, promoting student and faculty mobility has become increasingly important in higher education. Student and faculty mobility refers to the exchange of students and academic staff between institutions and countries, allowing them to gain international experience, broaden their perspectives, and contribute to cultural exchange and diversity (Knight2017). Students and faculty members from different countries and backgrounds bring diverse perspectives, knowledge, and experiences to the host institution. This exchange fosters a rich learning environment, encourages critical thinking, and promotes cross-cultural understanding. When students and faculty members engage in mobility programmes, they gain exposure to different teaching methods, research approaches, and academic resources. This exposure enhances their learning experience and equips them with valuable skills, such as adaptability, intercultural communication, and global awareness (Deardorff,. 2009). Faculty mobility promotes research collaboration between institutions and countries. It allows scholars to work together on joint research projects, share expertise, and exchange innovative ideas. Such collaborations contribute to the advancement of knowledge and address global challenges through interdisciplinary cooperation. Promoting student and faculty mobility aligns with the broader goal of internationalising higher education institutions. It helps institutions attract a diverse student body, enhance their global reputation, and establish international partnerships. These efforts contribute to the development of a

globally competitive and culturally inclusive higher education sector (Altbach, ., & Knight, 2007). In conclusion, promoting student and faculty mobility is crucial for fostering academic and cultural exchange, enhancing the learning experience, encouraging research collaboration, and internationalising higher education.

An Overview of Unilorin's Internationalisation Efforts

The University of Ilorin (Unilorin) is committed to fostering internationalisation and global engagement within its academic community. Recognising the importance of cross-cultural exchange, diversity, and collaboration, Unilorin has implemented various initiatives to promote internationalisation and enhance its global presence. Its internationalisation efforts encompass several key areas, including student mobility, faculty exchange, research collaborations and partnerships with international institutions. These efforts aim to provide students and faculty members with valuable opportunities for academic and cultural enrichment while contributing to the university's academic excellence and global reputation. Unilorin's internationalisation infrastructure includes the Centre for International Education (CIE), which serves as a focal point for coordinating international programs, managing partnerships, and supporting students and faculty members engaged in international activities.

The CIE actively promotes faculty exchange programmes, allowing faculty members to collaborate with international counterparts, share expertise, and engage in joint research projects. These collaborations facilitate knowledge exchange, enhance research output, and advance academic disciplines. Additionally, Unilorin's faculty members participate in international conferences, workshops, and seminars, enriching their professional development and expanding their networks. The CIE also encourages student mobility by offering various study abroad programmes, exchange opportunities, and internships with partner institutions worldwide. These programmes enable students to experience different educational systems, cultures, and perspectives, enhancing their global competence and cross-cultural understanding. The university also welcomes international students, fostering a diverse and inclusive learning environment (www.unilorin.edu.ng).

The CIE has established strategic partnerships and collaborations with reputable institutions worldwide. These partnerships facilitate faculty and

student exchange, joint research initiatives, curriculum development, and capacity-building programs. Through these collaborations, Unilorin promotes knowledge transfer, cultural understanding, and the exchange of best practices, further enhancing the university's global impact. To facilitate internationalisation efforts, CIE provides comprehensive support services to students and faculty members. The university offers guidance on study abroad opportunities, assists with visa processes, and provides pre-departure orientations.

Collaborative Initiatives and Partnerships of the University of Ilorin with Other Universities across the Globe

The University of Ilorin, one of Nigeria's leading academic institutions, has established numerous collaborations and partnerships with universities across the globe. These collaborative efforts contribute to the university's mission of promoting academic excellence, research innovation, and global engagement. These collaborations span various areas, including student and faculty exchanges, joint research projects, curriculum development, and capacity building programmes. By engaging in these collaborative initiatives, the University strives to enhance its academic programmes, promote diversity, and foster a global mindset among its students and faculty.

One notable collaborative initiative is the establishment of partnerships for student mobility programmes. The University has developed agreements with universities in different countries, allowing students to study abroad for a semester or a whole academic year. These partnerships provide students with an opportunity to experience different educational systems, cultures, and perspectives, contributing to their personal and intellectual growth. In addition, the University actively engages in research collaborations with international partners. Through these partnerships, faculty members from different disciplines collaborate on joint research projects that address global challenges and contribute to the advancement of knowledge. These collaborations often result in publications, conferences, and innovative solutions that have a positive impact on society. The University also prioritises capacity building initiatives by partnering with international institutions to offer training programmes, workshops, and seminars. These programmes aim to enhance the skills and knowledge of faculty members and administrative staff, enabling them to deliver high-quality education and

services. Through these collaborations, the University strengthens its institutional capacity and promotes professional development within its community (www.unilorin.edu.ng).

Case Examples of Successful Collaborations of the University of Ilorin

The University of Ilorin has actively pursued collaborations and partnerships with various institutions both within Nigeria and internationally. These collaborations have resulted in successful initiatives and projects that have contributed to the academic and research excellence of the University. The table below highlights the current MoUs of the University with other Institutions across the globe:

S/N	UNVERSITIES (MOU)	DATE OF LAST SIGNATURE
1.	The University of Gambia	2017-2022
2.	Texas A&M University, USA	2015-2020
3.	George Washington University	2015-2020
4.	AWAU	2015 till date
5.	C&IR-Institute of Minerals Material Technology, Bhubaneswar, India	2015-2020
6.	University of Kelaniya, Sri-Lanka	Undated
7.	Birmingham City University	2015-2020
8.	University of Kansas, Florida	2015-2020
9.	The University of Georgia, Athens, United State of African Studies (ASI)	2015-2020
10.	The University of Florida	2017-2022
11.	Reinhardt University Waleska Georgia	2017-2022
12.	Indian Institute of Tech and Madras, Chennai, India	2017-2022
13.	Aalto University School of Electrical Engineering, Finland	2015-2020

14.	Kyungpook National University, South Korea	2018-2021
15.	Kenyyata University, Nairobi, Kenya	2012-2022
16.	University of Abomey calavi, (Benin)	2019-2024
17.	University of Ghana Legon	2019-2024
18.	Swansea University, UK	2019-2022
19.	Alabama A&M University	2014-2019
20.	University of Torino, Italy	2023-2028
21.	University of Salford UK	2013-2017
22.	University of Glasgow Scotland	2023-2028
23.	Uka Tarsadia University, Gujarat, Indian	2023-2028
24.	Albany University, USA	In progress
25.	University of Regina, Canada	Active
26.	Chavan Law College, Pune, India	In progress
27.	Kwazulu-Nata, South Africa	2015 – 2020
28.	International Islamic University, Malaysia (IIUM)	2010-2015
29.	Ex-culture	In progress
30.	Arden University, UK	In progress
31.	Catholique University, Cameroon	2010-2015
32.	University of Wisconsin-Madison, USA	Active
33.	UNIVERSITY OF Cape Coast, UCC Ghana	2013-2018
34.	Sasakawa	2010-2015
35.	Ain Shams	Undated MoU
36.	Cape Peninsula University of Technology, South Africa	2009-2014

37.	University of Pretoria, South Africa	In progress
38.	University of Lome, Togo	2023
39.	Robert Gordon University (RGU)	In progress
40.	Temple University, USA	In progress
41.	Mykolas Romeris University, Luthinian, Europe	Active
42.	Virginal University	2009-2014
43.	Islamic University of Madinah (IUM)	In progress
44.	The Scaling School	Active
45.	Blue Economy	2024
46.	Opolo	2024
47.	WARIMA	2024
48.	WARI	2024
49.	De Monfort University, Leicester, United Kingdom	2024
50.	U6+ Consortium and KU8+	2024

Through the collaboration with abovementioned institutions and organisations, Unilorin has had student exchange with Kenyata University, with about 8 students visiting Unilorin and 6 unilorin students visiting Kenyata University The exchange was on semester based whereby the students spent a semester in the host university and carried the scores obtained back to their home university. Presently, two of Unilorin Law students are in Torino on student exchange. A lecturer from the faculty of Law, Dr Azubike, has just returned from the same Torino University on staff Exchange.

Based on the MoU signed with Wisconsin on the 19th May, 2016, a Memorandum of Agreement tagged 'Visiting Scientist Training' was entered into on the 15th May 2022, between the Board of Regents of the University of Wisconsin System on behalf of the University of Wisconsin-Madison and the University of Ilorin. Based on this agreement, three lecturers from Unilorin

visited Wisconsin between July 1 2016 and June 30 2018 for the training on Stem Cell research. They are: Dr Ibrahim Adisa, Dr Abiola Samuel Babatunde and Dr Olufunke Esan Olorundare. This set of staff had since returned to Nigeria and assumed duty at Unilorin. They are engaging in the retraining of staff and coordinating the activities of Stem Cell in the University. Another agreement was entered into with the same University on October 15, 2022 to train another set of two faculties namely: Dr David Animasaun and Dr Saheed Afolabi. The training, which was scheduled to last for 18 months, took effect from October 15, 2022 and ended on June 30, 2024.

As part of the activities of the Collaboration with Uka Tarsadia University (UTU), more than 7 faculties of Unilorin visited India with two postgraduate students. Professor R. Krishnamurthy of UTU visited Unilorin more than six times. In addition to teaching and research, he helped Unilorin in breeding rice and bananas, which is of India origin.

Nikolas Romario University's collaboration with Unilorin yielded one postgraduate student, Mrs Adebimpe, one non-academic staff member, Mrs Gambari and one faculty visitor to the university on exchange with the sponsorship of ERASMUS.

Unilorin has joined different consortia to organise conferences such as CUSAC Consortium, the U6 consortium, AWAU, WARIMA, KU8 and others.

These case examples highlight the University of Ilorin's commitment to fostering collaborations and partnerships that contribute to academic excellence, research innovation, and societal impact. Through these successful collaborations, the University has strengthened its position as a leading institution in Nigeria and has made significant contributions to various fields of knowledge.

Benefits of Partnerships and Inter-University Linkages

Academic Excellence and Innovation

The University of Ilorin has established itself as a leading institution in academic excellence and innovation. With a commitment to providing quality education, fostering research, and promoting innovation, the University has consistently demonstrated its dedication to shaping the future of higher education in Nigeria and beyond. It has a long-standing reputation for

academic excellence. It is consistently ranked among the top universities in Nigeria and has received numerous accolades for its academic programs. According to the 2014 University Web Ranking conducted by 4 International Colleges and Universities (4ICU), UNILORIN ranked number 1 in Nigeria, 20th in Africa. The university's commitment to quality education is reflected in its rigorous admission process, highly qualified faculty members, and comprehensive curriculum. The university offers a wide range of undergraduate and postgraduate programmes across various disciplines, including sciences, arts, social sciences, engineering, and medical sciences (www.unilorin.edu.ng). These programmes are designed to meet national and international standards and provide students with a solid foundation in their chosen fields.

In addition to its strong academic programmes, the University of Ilorin provides a conducive learning environment with state-of-the-art facilities such as well-equipped laboratories, libraries, and research centers. The University also emphasises the use of technology in teaching and learning, integrating e-learning platforms and digital resources to enhance the educational experience. The University has a vibrant research culture and has made significant contributions to various fields of knowledge. Faculty members actively engage in research and have published numerous scholarly articles in reputable journals. The university encourages interdisciplinary research collaborations and provides support for faculty members to pursue research grants and projects.

The institution has also fostered a culture of innovation and entrepreneurship among its students. Various initiatives, such as the Technical and Entrepreneurship Centre (TEC), have been introduced to promote creativity, problem-solving, and business acumen (www.unilorin.edu.ng). These efforts aim to equip students with the necessary skills and mindset to thrive in a rapidly changing global economy. The University has established research centers and institutes to address societal challenges and contribute to national development. These centers focus on areas such as agriculture, health, renewable energy, and information technology. Through these research endeavors, the University aims to provide practical solutions to real-world problems and make a positive impact on society.

Unilorin International Research Networks

The University of Ilorin recognises the significance of international collaboration in fostering research excellence and innovation. To enhance global research engagement, the University has established Centre for International Education (CIE) that facilitates collaborations with renowned institutions and researchers worldwide. These networks serve as platforms for knowledge exchange, interdisciplinary research, and collaborative projects in various fields of study. The University International Centre brings together researchers, scholars, and experts from diverse backgrounds to collaborate on cutting-edge research topics. These networks aim to address global challenges, promote knowledge creation, and contribute to the advancement of scientific understanding. By connecting researchers across borders, the University fosters cross-cultural perspectives and encourages interdisciplinary collaboration.

The University of Ilorin spans a wide range of disciplines, including but not limited to science, technology, engineering, humanities, social sciences, and health sciences. Each network focuses on specific research areas, enabling scholars to share expertise, exchange ideas, and undertake collaborative research projects of mutual interest. Through the CIE, researchers at the University of Ilorin have opportunities to engage in joint research activities such as collaborative projects, co-publications, data sharing, and research exchange programs. These initiatives not only enhance the quality and impact of research conducted at the university but also contribute to global knowledge dissemination and academic recognition. The University actively seeks partnerships and collaborations with renowned international institutions and organisations to expand its research networks. These collaborations are facilitated through memoranda of understanding, research agreements, and joint funding initiatives. By leveraging the expertise and resources of its partners, the University aims to address complex research challenges and make meaningful contributions to society.

Furthermore, the establishment of the Centre for Research Development and In-house Training (CREDIT) at the University of Ilorin also provides opportunities for capacity building and professional development for researchers. They organise workshops, seminars, conferences, and training programs, both locally and internationally, to enhance research skills, promote

interdisciplinary collaboration, and foster networking among researchers. In 2021, two University of Ilorin dons, Prof. Joshua Olaoye and Dr Musliu Sunmonu, won a research grant of £233,780 from the Innovate UK African Agriculture Knowledge Transfer Partnership (KTP). (Mohammed-Lawal, 2021).

The former Director of the Centre Prof. Olugbenga Mokuolu, an expert in Paediatrics and Child Health, University of Ilorin (UNILORIN) won several grants on malaria. He has been elected Co-Chair of Roll Back Malaria (RBM) Partnership Case Management Working Group. (Mohammed-Lawal, 2024).

Unilorin Cultural Diversity and Global Perspective

University of Ilorin embraces and celebrates cultural diversity while fostering a global perspective among its students, faculty, and staff. Recognising the importance of a multicultural learning environment, the university promotes inclusivity, intercultural understanding, and global citizenship. The diverse student body at the University of Ilorin consists of students from various ethnic, religious, and cultural backgrounds. This diversity enriches the academic experience by exposing students to different perspectives, traditions, and worldviews. It creates a vibrant campus community where students can learn from one another, challenge stereotypes, and develop a greater appreciation for cultural differences.

The university actively promotes cultural diversity through various initiatives and activities. Orientation for newly admitted International students, International students' day celebration, and acculturation are organised to celebrate the traditions, languages, and customs of different cultures represented within the international community of the university. These events provide an opportunity for students to showcase their cultural heritage, learn about other cultures, and foster a sense of belonging and mutual respect. Furthermore, the University of Ilorin encourages internationalisation and global engagement through exchange programs, partnerships with international institutions, and collaborative research projects. These initiatives provide students and faculty members with opportunities to broaden their horizons, engage in cross-cultural interactions, and gain a global perspective.

The University also offers courses and programmes that emphasise global issues, intercultural communication, and international perspectives. By integrating global themes into the curriculum, the University of Ilorin prepares

students to be global citizens who are knowledgeable about global challenges, sensitive to cultural diversity, and capable of contributing to a more inclusive and interconnected world. In addition to academic endeavours, the University of Ilorin promotes cultural diversity through student organisations, clubs, and societies. These groups provide platforms for students to come together based on shared interests, cultural backgrounds, or international affiliations. They organise cultural events, discussions, and community service activities that promote intercultural dialogue, friendship, and cooperation. The University's commitment to cultural diversity and global perspective extends to its faculty and staff. The University of Ilorin encourages diversity in its recruitment practices, ensuring that the faculty and staff reflect a range of backgrounds and experiences. This diverse representation among the faculty and staff enhances the quality of education, research, and institutional decision-making, while fostering an inclusive and equitable environment for all.

Challenges and Strategies

Institutional Barriers

The University of Ilorin, like any other institution, faces various challenges related to institutional barriers that may hinder its effectiveness and hinder the achievement of its goals. These barriers can include bureaucratic processes, inadequate resources, hierarchical structures, and resistance to change. However, the University has implemented strategies to address these challenges and create a more conducive and progressive environment for all stakeholders. One of the primary challenges faced by the University of Ilorin is bureaucratic processes. These barriers can slow down decision-making, hinder innovation, and impede the effective implementation of policies and initiatives. To overcome these challenges, the University has taken steps to streamline administrative processes, enhance transparency, and improve communication channels between different departments and units. By simplifying procedures and promoting a culture of efficiency, the University aims to reduce bureaucratic barriers and foster a more agile and responsive institution. Inadequate resources pose another significant challenge for the University. Limited funding, outdated infrastructure, and insufficient equipment is hindering the quality of education, research, and overall institutional performance. To address this challenge, the University has focused on diversifying its sources of funding, seeking external grants and

partnerships, and engaging in fundraising activities. These efforts aim to secure additional resources to support academic programs, infrastructure development, and research initiatives. Additionally, the University has implemented prudent financial management practices to optimise resource allocation and ensure effective utilisation of available funds.

Hierarchical structures and rigid organisational cultures can also create institutional barriers within the University of Ilorin. These barriers can impede collaboration, hinder decision-making at lower levels, and limit opportunities for innovation and creativity. In response, the University has embraced a more participatory approach to decision-making and encouraged open communication across different levels of the institution. By fostering a culture of inclusivity and empowering staff and students, the University aims to break down hierarchical barriers and promote a sense of ownership and shared responsibility. (www.unilorin.edu.ng)

Resistance to change is another challenge that many institutions face, including the University of Ilorin. Change initiatives, such as the implementation of new policies regarding internationalisation drive, curriculum reforms, or technological advancements, can face resistance from various stakeholders. To address this challenge, the University has focused on creating awareness, providing training and capacity-building programs, and emphasising the benefits of change. By involving stakeholders in the decision-making process and addressing their concerns, the University aims to overcome resistance and create a more adaptable and progressive institution.

Cultural and Linguistic Differences

The University, as a diverse and inclusive institution, recognises and celebrates the cultural and linguistic differences among its students, faculty, and staff. It embraces the richness and diversity of its community, fostering an environment that promotes cultural understanding, respect, and inclusivity. It is also a home to a diverse student body, with students coming from various cultural backgrounds, ethnicities, and regions within Nigeria and around the world. These cultural differences contribute to a vibrant and enriching learning environment, where students have the opportunity to interact with peers from different traditions, customs, and perspectives. The University encourages cultural exchange through events, festivals, and cultural showcases that promote the sharing of traditions, arts, and cultural heritage.

Faculty and staff members at the University of Ilorin also bring diverse cultural experiences and perspectives to the institution. This diversity enriches the academic environment, enabling a wide range of knowledge and ideas to be shared within classrooms, research projects, and academic discussions. The university values the contributions of its diverse faculty and staff, recognising that cultural differences can lead to new insights, innovative approaches, and interdisciplinary collaborations. The university acknowledges the importance of linguistic diversity and strives to create an inclusive environment where all languages are respected. English is the official language of instruction and communication at the University of Ilorin. However, the institution recognises the need for multilingualism and offers support services to improve English language proficiency for students whose first language is not English, thereby establishing Linguistic Immersion Centre (LIC) to immerse students from francophone countries. Additionally, efforts are made to preserve and promote Nigerian languages through cultural events, language clubs, and initiatives that celebrate linguistic diversity. The University of Ilorin is committed to ensuring that cultural and linguistic differences are respected and embraced across all aspects of campus life. By fostering an inclusive environment, the university encourages cross-cultural interactions, promotes cultural sensitivity, and provides opportunities for students and faculty to learn from one another. (www.unilorin.edu.ng)

Strategies Employed by Unilorin to Overcome Challenges

The University of Ilorin has faced various challenges throughout its history, but it has consistently employed effective strategies to overcome these obstacles and maintain its commitment to academic excellence and institutional growth. By implementing proactive measures and adopting innovative approaches, the university has successfully navigated challenges and continued to thrive in the face of adversity.

Strategic Planning: The University of Ilorin places great emphasis on strategic planning to anticipate and address challenges effectively. The institution engages in comprehensive long-term planning, setting clear goals and objectives aligned with its vision. Through strategic planning, the university identifies potential challenges, formulates action plans, and allocates resources strategically to overcome obstacles and achieve its desired outcomes.

Research and Innovation: The University recognises the importance of research and innovation in addressing challenges and driving institutional growth. It encourages faculty and students to engage in cutting-edge research, fostering a culture of innovation and problem-solving. By promoting research-driven solutions, the University of Ilorin tackles challenges in various fields, contributing to knowledge creation and societal development.

Collaboration and Partnerships: The University of Ilorin actively seeks collaborations and partnerships with other academic institutions, industry partners, and government agencies. By forging strategic alliances, the university gains access to additional expertise, resources, and funding opportunities. Collaborative efforts enable the institution to tackle complex challenges collectively, leveraging collective knowledge and experience.

Capacity Building and Professional Development: The University invests in capacity building and professional development programs for faculty, staff, and students. By enhancing their skills and knowledge, individuals are better equipped to overcome challenges and adapt to changing circumstances. The University of Ilorin offers training programs, workshops, and seminars to enhance technical, managerial, and leadership capabilities, fostering a culture of continuous learning and growth.

Student Support Services: Recognising the importance of student success, the university provides comprehensive support services to students facing challenges. These services include counselling, academic advising, mentoring programs, and career guidance. By addressing students' personal and academic needs, the university ensures that they have the necessary support to overcome challenges and thrive in their educational journey.

I**nfrastructure Development:** The University of Ilorin invests in the development of modern infrastructure and facilities to meet the evolving needs of its academic community. Upgrading and expanding infrastructure enhances the teaching, learning, and research environment, enabling the institution to overcome challenges related to limited resources and outdated facilities.

Continuous Quality Improvement: The University emphasises a culture of continuous quality improvement, regularly assessing its programs, processes, and services to identify areas for enhancement. By soliciting feedback from stakeholders and benchmarking against international standards, the institution

identifies challenges and implements measures to address them effectively, ensuring the delivery of high-quality education and services. (www.unilorin.edu.ng)

Conclusion and Recommendations

Partnerships and inter-university linkages serve as strategic tools for the internationalisation of universities, as demonstrated in this study of Unilorin. The university's commitment to fostering collaborations and establishing partnerships with institutions globally has played a significant role in enhancing its international presence, promoting academic excellence, and providing enriching opportunities for students and faculty members. Through its partnerships and inter-university linkages, Unilorin has gained access to a wide range of resources, expertise, and diverse perspectives that have enriched its academic programs and research endeavours. Collaborative initiatives have allowed for the exchange of knowledge, research collaborations, joint publications, and joint projects, contributing to the advancement of scientific understanding and addressing global challenges.

Furthermore, partnerships and inter-university linkages have facilitated student and faculty mobility programs, enabling the University of Ilorin community to engage in international experiences. Students have had the opportunity to study abroad, participate in exchange programs, and gain exposure to different cultures and academic environments. Faculty members have benefited from research visits, conferences, and collaborative projects, enhancing their professional development and contributing to the university's research output.

Recommendations:

Based on this study of Unilorin, the following recommendations can be made to further strengthen and leverage partnerships and inter-university linkages for the internationalisation of universities:

a- **Expand and Diversify Partnerships:** Unilorin should continue to actively seek and establish partnerships with diverse institutions worldwide. Strengthening existing partnerships and exploring new collaborations will provide opportunities for faculty and students to engage in a broader range of international experiences and research collaborations.

b- **Strategic Focus:** The University should strategically identify key areas of focus for partnerships and linkages that align with its academic strengths and research priorities. By targeting specific disciplines or thematic areas, Unilorin can maximise the impact of its collaborations and enhance its global reputation in those fields.

c- **Enhance Support Services:** The University should provide comprehensive support services for students and faculty members engaged in international partnerships and inter-university linkages. This includes assistance with visa processes, funding opportunities, cultural orientation, and logistical support, ensuring a smooth and successful experience for all participants.

d- **Establish Joint Degree Programs**: Unilorin should explore the establishment of joint degree programs with partner institutions. Joint degree programs offer students the opportunity to earn a degree from both institutions, providing them with a truly international educational experience and enhancing their employability in the global job market.

e- **Foster Research Networks:** The University should encourage the formation of research networks and consortia with partner institutions. These networks can facilitate collaborative research projects, joint funding applications, and knowledge sharing, strengthening the research capabilities of Unilorin and its partners.

f- **Promote Faculty Development:** Unilorin should invest in faculty development programs that equip faculty members with the skills and competencies necessary for effective international collaborations. This includes providing training on intercultural communication, grant writing, project management, and research collaboration.

In conclusion, partnerships and inter-university linkages are strategic tools for the internationalisation of universities, as demonstrated by the case study of the University of Ilorin. By expanding and diversifying partnerships, focusing on strategic areas, enhancing support services, establishing joint degree programs, fostering research networks, and promoting faculty development, Unilorin can further leverage these tools to enhance its international presence and academic excellence.

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CHAPTER SEVEN

Assessment of Neurochemical and Biochemical Safety of Levonorgestrel in Female Wistar Rats: Implications for Quality Assurance in Contraceptive Use and Supplement Co-administration

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Abstract

This study investigated the neurobiological effects of levonorgestrel (LNG), a widely used contraceptive medication, and the potential modulatory role of melatonin, a readily available supplement. Using a female Wistar rat model, the research examined the effects of varying dosages and exposure frequencies of LNG, alone and in combination with melatonin, on neuro-oxidative stress, lipid profiles, and bioenergetics. The findings of this study have significant implications for global health and well-being, particularly in ensuring medication safety and promoting sustainable health practices. The research contributed to a broader understanding of pharmaceutical impacts on diverse populations worldwide, addressing challenges in quality assurance and safe medication use. The study's results can inform educational initiatives regarding responsible medication use and supplement co-administration, ultimately promoting public health and well-being.

Keywords: Levonorgestrel, Melatonin, Neurobiology, Global Health.

Introduction

Levonorgestrel (LNG), a synthetic progestogen, is widely used in emergency contraceptive pills (ECPs) and hormonal contraceptives (Glasier et al., 2011). While its efficacy in preventing unintended pregnancies is well-established, concerns regarding its potential neurochemical and biochemical effects have emerged (Kallner and Danielsson, 2016). Understanding these effects is crucial for ensuring the safety and quality assurance of contraceptive use,

particularly in the light of the global prevalence of hormonal contraceptive usage (Rudzinski et al., 2023; UNPD, 2018). Furthermore, the co-administration of supplements like melatonin (MLT) with LNG warrants investigation to determine potential modulatory effects and ensure the safety of combined usage.

Neurochemical assessments are essential to evaluate the impact of LNG on brain function, as hormonal fluctuations can influence neurotransmitter systems and neuronal integrity (McEwen, 2012). Biochemical parameters, including lipid profiles and oxidative stress markers, provide insights into systemic effects and potential adverse outcomes. Disruptions in these parameters may indicate increased cardiovascular risk or compromised cellular function. This study aimed to assess the neurochemical and biochemical safety of LNG in female Wistar rats, simulating human dosages and frequencies of exposure. By evaluating various endpoints, including brain and serum lipid profiles, oxidative stress markers, and enzyme activities, the study sought to elucidate the potential risks associated with LNG use and the protective role of MLT co-administration. The findings would have significant implications for quality assurance in contraceptive use and supplement co-administration, informing clinical practice and public health guidelines.

Materials and Methods

Experimental Animals

Forty (40) mature female Wistar rats (average 200g) were used. They were housed under controlled conditions (temperature, humidity, light cycle). The animals were acclimatised for 15 days and had free access to food and water. All procedures were approved by the University of Ilorin Animal Care Committee and followed NIH guidelines.

Treatments

Levonorgestrel (LNG) was dissolved in 0.9% saline to simulate human doses in rats (4 μg/kg and 8 μg/kg). Melatonin was also dissolved in 0.9% saline (10mg/kg).

Experimental Design

The study looked at the effects of regular (once weekly) and frequent (three times weekly) LNG exposure at recommended dose (simulation, 4 µg/kg) and misused high dose (8 µg/kg) respectively. Rats were divided into five (5) main groups: control, low-dose LNG, high-dose LNG, low-dose LNG + melatonin, and high-dose LNG + melatonin. Each group was further divided into regular exposure (RE, once weekly) and frequent exposure (FE, three times weekly). Treatments were administered orally via gavage for eight weeks.

Sample Collection

Animals were euthanised, and blood samples were collected for serum analysis. Brain tissues were collected and homogenised for neurochemical analysis.

Biochemical Parameters

Lipid profiles (total cholesterol, triglycerides, HDL-C, LDL-C, VLDL-C, non-HDL-C, AIR, CRR) were measured. Very low density lipoproteins-cholesterol (VLDL-C) was assessed as one-fifth of TG and low density lipoproteins-cholesterol (LDL-C) was estimated using Friedewald's formula: [LDL-C= TC – (HDL-C + VLDL) mg/g (Friedewald et al., 1972). Also, Non-HDL-C was calculated by estimating the differences between total cholesterol and high densit lipoprotein cholesterol [Non-HDL-C=TC-HDL-C]. The Atherogenic Index Risk (AIR) was evaluated by: Log (TG/HDL-C) and Cardiovascular Risk Ratios (CRR) by: CRRI= TC/HDL-C ratio; CRRII= LDL-C/HDL-C ratio (Dobiasova, 2004).

Lipid peroxidation (MDA) and nitric oxide (NO) levels were determined. Antioxidant enzyme activities (SOD, GPx, CAT, GSH, G6PDH) were measured.

Data Analysis

GraphPad Prism 8.0 was used for statistical analysis. Data were presented as mean ± SEM. One-way ANOVA followed by Tukey's post hoc test was used to determine statistical significance at $p < 0.05$.

Results and interpretations

The available data analysis were presented in tables 1-3.These tables present the effects of Levonorgestrel (LNG) and Melatonin (MLT) on various

biochemical parameters in the brain and serum of female Wistar rats, with varying frequencies of LNG exposure (once or thrice weekly). The significance of these findings relates to the potential neurotoxicity of LNG and the protective role of MLT, which has implications for understanding the impact of pharmaceuticals on biological systems. In the context of globalised education, this type of research is crucial for ensuring quality assurance in scientific methodologies and the ethical use of experimental models.

Effect of LNG and/or MLT on brain Cholesterol and Lipoproteins:

In the brain, high-dose LNG administered once weekly significantly decreased total cholesterol and LDL levels compared to the control group (Table 1). This suggests a potential disruption of lipid metabolism within the central nervous system. Equally, frequent LNG exposure (thrice weekly) led to increased total cholesterol and LDL levels, highlighting the dosage-dependent effects of LNG on brain lipid profiles. Melatonin co-administration generally attenuated the adverse effects of LNG, particularly at the higher dose, suggesting a protective role against LNG-induced lipid dysregulation. This is important, because changes to lipid profiles within the brain, can profoundly affect neurological function (Alghamdi, 2018; Reiter et al., 2016).

Cardiovascular Risk Ratios (CRR) and Atherogenic Coefficient (AC):

The CRR I, CRR II and AC indices, which reflect cardiovascular risk, were significantly reduced in the LNG plus MLT groups (once weekly). This implies that melatonin exhibited a protective effect against potential cardiovascular complications induced by LNG (Table 1). Frequent LNG exposure, however, increased these risk ratios, suggesting a heightened cardiovascular risk with increased LNG frequency. These results provide important information relating to the systemic effects of LNG, and the potential protective properties of MLT (Table 1).

Implications for Assessment and Quality Assurance:

These findings emphasised the importance of rigorous assessment and quality assurance in pharmaceutical research, particularly when investigating potential neurotoxic effects and systemic impacts of drugs. The inclusion of multiple parameters and statistical analysis (ANOVA, Tukey's post hoc) ensured the reliability and validity of the results, aligning with best practices in scientific research.

Table 1: Effects of Levonorgestrel and Melatonin on lipid profiles and indices in the brain of female Wistar rats

Treatments /Parameters	NS 1 ml/kg	LNG 4 µg/kg	LNG 8 µg/kg	LNG 4 µg/kg /MLT 10 mg	LNG 8 µg/kg /MLT 10 mg
Brain Total Cholesterol mg/dL					
Once /week	405.12±17.85	421.44±18.33	313.68±11.96*	241.23±13.37*	310.59±1.54*
Thrice/week	197.30±17.42	235.84±15.39	296.72±13.70#	322.16±8.16#	379.86±15.52#
Brain Triacylglyceride mg/dL					
Once /week	324.26±4.14	295.27±8.22*	283.78±10.60*	246.15±2.13*	265.68±12.98*
Thrice/week	235.51±4.61	258.70±8.45*	308.88±8.13*	291.71±4.84*	310.99±5.89*
Brain very low density lipoproteins (VLDL) mg/dL					
Once /week	64.85±0.83	59.05±1.64*	56.76±2.12*	49.23±0.43*	53.14±2.59*
Thrice/week	47.10±0.92	51.74±1.69*	61.78±1.63*	58.34±0.97*	62.19±1.18*
Brain high density lipoprotein (HDL) mg/dL					
Once /week	30.37±2.83	29.54±1.25	27.24±2.71	27.15±2.01	32.30±0.83
Thrice/week	24.02±2.63	25.77±1.81	28.07±1.53	28.89±1.99	29.08±2.17
Brain low density lipoprotein (LDL) mg/dL					
Once /week	309.89±15.23	332.84±15.60	229.68±13.28*	164.85±14.85*	225.16±3.18*
Thrice/week	126.18±14.28	158.33±16.89	206.88±13.98*	234.91±9.88*	288.58±13.18*
Brain non-HDL mg/dL					
Once /week	374.75±15.97	391.89±17.21	286.44±13.00*	214.08±15.26*	278.29±0.71*
Thrice/week	173.28±15.20	210.07±17.01	268.65±14.00*	293.26±8.96*	350.78±14.34*
Cardiovascular risk ratio l (CRR I)					
Once /week	13.51±1.04	14.27±0.28	11.75±1.24	9.06±1.20*	9.63±0.20*
Thrice/week	8.27±0.49	9.31±1.14	10.64±0.85	11.26±0.87*	13.15±0.76*
Cardiovascular risk ratio ll (CRR II)					
Once /week	10.34±0.85	11.27±0.24	8.64±1.11	6.22±1.05*	6.97±0.11*
Thrice/week	5.27±0.39	6.27±0.99	7.42±0.72	8.23±0.78*	9.99±0.64*

Atherogenic coefficient (AC)					
Once /week	12.51±1.04	13.27±0.28	10.75±1.24	8.06±1.21*	8.63±0.20*
Thrice/week	7.27±0.49	8.31±1.14	9.64±0.85	10.26±0.87*	12.15±0.76*

*Data were expressed as mean ±SEM; once per week (RE-regular exposure) *P<0.05 vs. NS (control group) and thrice per week (FE-frequent exposure) #P<0.05 vs. NS (control group)*

Effect of LNG and/or MLT on serum lipid profiles and cardiovascular risk

Levonorgestrel (LNG) treatment, especially at 4 µg/kg, consistently lowered total cholesterol, triacylglycerides, VLDL, LDL, and non-HDL levels compared to the control (NS). LNG, particularly at 4ug/kg once a week, and 8ug/kg thrice a week, resulted in elevated HDL levels. The combination of LNG and melatonin generally showed a further improvement in lipid profiles, suggesting a synergistic effect. LNG and LNG+MLT treatments significantly reduced cardiovascular risk ratios (CRR I and CRR II) and the atherogenic coefficient (AC), indicating a lower risk of cardiovascular disease.

The frequency of administration (once vs. thrice weekly) influenced the magnitude of the effects, with some variations observed between the two schedules. These changes in serum lipid profiles may reflect systemic effects of LNG, impacting lipid metabolism beyond the brain. The use of serum lipid levels is a common practice when assessing the overall health of the test subject (Table 2).

Table 2: Effects of Levonorgestrel and Melatonin on lipid profiles and indices in the serum of female Wistar rats

Treatments/ Parameters	NS 1 ml/kg	LNG 4 µg/kg	LNG 8 µg/kg	LNG 4 µg/kg /MLT 10 mg	LNG 8 µg/kg /MLT 10 mg
Serum Total Cholesterol					
Once /week	220.42±5.05	176.49±8.58*	207.32±22.39	200.39±10.71	184.20±2.78
Thrice/week	219.65±18.49	170.32±5.05 #	185.74±12.11	185.74±13.50	191.99±3.14
Serum triacylglyceride					
Once /week	217.75±9.52	160.95±11.24*	200.59±15.51	185.21±16.34	165.09±5.12*

Thrice/week	219.53±23.76	154.44±5.71*	161.54±9.78*	158.58±8.71*	156.22±5.12*
Very low density lipoproteins (VLDL)					
Once /week	43.55±1.90	32.19±2.25*	40.12±3.10	37.04±3.27	33.02±1.02*
Thrice/week	43.91±4.75	30.89±1.14*	32.31±1.96*	31.72±1.74*	31.25±1.02*
High density lipoprotein HDL					
Once /week	38.47±1.93	53.01±5.89*	33.50±3.13	40.31±3.92	47.31±2.18
Thrice/week	40.49±3.93	41.32±3.95	52.46±2.77*	55.49±4.25*	45.39±1.76
Low density lipoprotein (LDL)					
Once /week	138.40±2.94	91.29±8.91*	133.70±21.32	123.03±10.82	103.88±4.27
Thrice/week	135.25±17.90	98.11±6.69*	100.97±10.43	98.53±13.95	115.36±3.87
Serum Non-HDL					
Once /week	181.95±4.27	123.48±11.14*	173.82±24.13	160.07±14.09	136.89±4.66*
Thrice/week	179.16±22.29	129.00±7.79*	133.28±12.33*	130.24±15.47*	146.60±4.89
Cardiovascular risk ratio l (CRR I)					
Once /week	5.75±0.23	3.42±0.48*	6.34±1.05	5.12±0.81	3.91±0.22
Thrice/week	5.60±0.92	4.20±0.43	3.56±0.31*	3.39±0.39*	4.25±0.23
Cardiovascular risk ratio ll (CRR II)					
Once /week	3.61±0.19	1.79±0.36*	4.13±0.89	3.17±0.62	2.21±0.18
Thrice/week	3.45±0.71	2.44±0.35	1.94±0.25*	1.82±0.33*	2.56±0.18
Atherogenic coefficient (AC)					
Once /week	4.75±0.23	2.42±0.48*	5.35±1.05	4.12±0.81	2.91±0.22
Thrice/week	4.60±0.92	3.20±0.43	2.56±0.31*	2.39±0.39*	3.25±0.23

Data were expressed as mean ±SEM; once per week (RE-regular exposure)
**P<0.05 vs. NS (control group) and thrice per week(FE-frequent exposure)*
#P<0.05 vs. NS (control group)

Effects of Levonorgestrel and Melatonin on redox status and bioenergetics in the brain of female Wistar rats

Frequent LNG and /or Melatonin exposure (FE) improves energy metabolism by activating the AST and LDH activities but co-administered LNG/MLT at RE decreases LDH activity when compared to control (Table 3).

Levonorgestrel (LNG) and /or Melatonin effects on oxidative stress markers

Levonorgestrel (LNG), used in hormonal contraceptives, may have neurobiological effects. This parameter explored the impact of LNG on brain enzyme activities and oxidative stress markers (Song et al., 2023). The result shows that LNG, especially when administered thrice weekly, significantly increases aspartate transferase (AST) and lactate dehydrogenase (LDH) levels. This suggests potential cellular damage or altered metabolic activity in the brain (Zhang et al., 2016). The effects of LNG on oxidative stress markers; malondialdehyde MDA, and nitric oxide (NO) and antioxidant enzymes; superoxide dismutase (SOD), glutathione peroxidase (GPx), Catalase (CAT) are variable and depend on the dosage and frequency of administration.

Malondialdehyde MDA is a marker of lipid peroxidation, indicating oxidative damage. The data shows that LNG, in some combinations with MLT, reduces MDA levels, suggesting a potential antioxidant effect of the combined treatment. Nitric oxide NO plays a complex role in the brain. LNG significantly reduced NO levels when administered once a week. This implies that the NO-signaling related pathway may be disrupted. SOD, GPx, and catalase are antioxidant enzymes. Their activities reflect the brain's ability to combat oxidative stress. The results are varied, showing both increases and decreases depending on the treatment (Rummel and Butterfield, 2022).

Melatonin, a neuroprotective hormone, is often used to counteract oxidative stress (Tarocco et al., 2019). The combination of LNG and MLT appears to modulate the effects of LNG. In some cases, MLT seems to mitigate the adverse effects of LNG, particularly on LDH and MDA levels (Hardeland, 2018). However, the results are complex and needs more research to understand the full interaction of these two substances.

Levonorgestrel (LNG) and /or Melatonin effects on LDH, AST, AChE and G6PDH activities for neuronal membrane integrity

Aspartate transferase (AST) and lactate dehydrogenase (LDH) are indicators of cellular damage. Elevated levels suggest potential neurotoxicity. These enzymes also serve as bioenergetics marker for neuronal metabolic function. AChE is involved in neurotransmission. Changes in AChE activity can affect cognitive function. The result shows that some treatments increased AChE activity. Alteration in the Ach/AChE ratio (acetylcholine/cholinesterase ratio) may influence cholinergic-like discharge and cognitive outflow. G6PDH is an enzyme in the pentose phosphate pathway, crucial for producing NADPH, which is essential for antioxidant defense, in the iodination of thyroglobulin during the synthesis of thyroid hormones and reductive biosynthesis like steroids. The results of this measurement are very varied. This may be attributable to frequency of administration**;** thrice-weekly administration generally leads to more pronounced changes in enzyme activities and oxidative stress markers.

Potential Implications:

This study revealed the interaction between levonorgestrel and/or melatonin supplement (LNG/MLT) in the brain of female animal model. Here, the generated dataset suggested that LNG may have neurobiological effects, and MLT can modulate these effects. The findings highlighted the importance of considering the frequency and dosage of LNG administration.

Further research is needed to elucidate the underlying mechanisms and clinical implications of these findings.

Table 3: Effects of Levonorgestrel and Melatonin on redox status and bioenergetics in the brain of female Wistar rats

Treatments /Parameters	NS 0.3 ml	LNG 4 µg/kg	LNG 8 µg/kg	LNG 4 µg/kg /MLT 10 mg	LNG 8 µg/kg /MLT 10 mg
Brain Aspartate Transferase (AST) U/L					
Once /week	35.38±1.29	41.26±4.92	38.71±3.69	41.97±0.91	43.67±3.14
Thrice/week	15.52±2.14	41.48±3.55*	43.74±4.97*	41.26±2.56*	46.72±1.73*
Brain Lactate dehydrogenase (LDH) U/L					

Once /week	1537.58±30.73	1468.22±16.69	1498.02±17.75	1365.78±61.55*	1333.51±62.11*
Thrice/week	191.59±5.97	1432.42±18.77*	1518.31±8.68*	1434.04±36.54*	1400.15±33.48*
Brain Malondialdehyde MDA µM					
Once /week	1.03±0.07	0.98±0.08	1.23±0.29	0.72±0.02	0.52±0.01*
Thrice/week	0.88±0.18	0.81±0.18	1.03±0.11	0.62±0.06	0.55±0.09
Brain Nitric oxide (NO) µM					
Once /week	16.59±1.70	10.54±0.51*	10.34±2.04*	7.30±0.95*	7.43±1.08*
Thrice/week	5.15±1.19	5.19±0.61	8.70±1.88	8.57±1.18	8.54±1.36
Brain SOD activity µ/ml					
Once /week	0.66±0.11	0.60±0.09	0.78±0.19	0.81±0.18	0.56±0.06
Thrice/week	0.53±0.10	0.91±0.39	0.56±0.07	0.65±0.07	0.55±0.09
Brain GPx activity U/L					
Once /week	27.34±3.37	18.55±1.50	15.38±3.00	15.00±1.50	21.00±8.65
Thrice/week	10.88±0.99	21.76±5.45	31.13±4.88*	24.38±7.61	14.25±0.99
Brain Catalase activity U/mg protein					
Once /week	17.62±3.59	15.89±3.65	14.62±2.73	21.69±1.79	24.10±3.45
Thrice/week	16.63±2.22	14.59±0.75	17.42±1.44	24.94±4.01	17.29±3.68
Brain GSH U/L					
Once /week	1.77±0.21	1.72±0.17	1.58±0.03	1.41±0.05	1.44±0.04
Thrice/week	1.73±0.16	1.69±0.09	1.75±0.25	1.62±0.35	1.56±0.43
Brain G6PDH U/L					
Once /week	42.84±14.24	6.59±1.47*	23.13±4.20	26.65±4.20	25.52±5.46
Thrice/week	9.00±3.72	12.61±4.78	26.85±17.23	42.64±10.96*	15.97±2.44
Brain AChE µmol					
Once /week	0.08±0.00	0.06±0.00	0.07±0.01	0.07±0.01	0.07±0.00
Thrice/week	0.04±0.00	0.06±0.00	0.06±0.01	0.07±0.01*	0.07±0.00*

*Data were expressed as mean ±SEM; once per week (RE-regular exposure) *P<0.05 vs. NS (control group) and thrice per week (FE-frequent exposure) #P<0.05 vs. NS (control group)*

Discussion

The present study investigated the neurochemical and biochemical effects of levonorgestrel (LNG) administration in female Wistar rats, with a focus on assessing potential adverse outcomes and the modulatory role of melatonin (MLT). The data revealed significant alterations in lipid profiles, oxidative stress markers, and enzyme activities, highlighting the importance of thorough safety assessments in contraceptive use. In the brain, high-dose LNG administered once weekly significantly decreased total cholesterol and LDL levels, while frequent exposure increased these parameters. This suggests that LNG's impact on brain lipid metabolism is dose-and frequency-dependent. The observed changes in lipid profiles may reflect disruptions in cholesterol homeostasis, which is crucial for neuronal function and membrane integrity (Yang et al., 2022; Pfrieger, 2003).

Serum lipid profiles also showed significant alterations, with LNG administration leading to decreased total cholesterol and triacylglyceride levels but increased HDL levels (Pfrieger, 2003). These systemic effects may indicate that LNG influences lipid metabolism beyond the central nervous system. The cardiovascular risk ratios (CRR) and atherogenic coefficient (AC) were significantly reduced in the LNG-MLT co-administrated groups, suggesting a protective role of melatonin against potential cardiovascular complications. Given that cardiovascular health is a major concern globally, this is an important finding.

These findings underscore the importance of lipid profile monitoring in individuals using LNG-based contraceptives, particularly those with pre-existing cardiovascular risk factors. The protective effects of MLT highlight the potential benefits of supplement co-administration in mitigating adverse lipid-related effects. Frequent LNG exposure significantly increased aspartate transferase (AST) and lactate dehydrogenase (LDH) levels in the brain, indicating potential neurotoxicity. These enzymes are markers of cellular damage, suggesting that LNG may compromise neuronal integrity (He et al., 2023).

Oxidative stress, as indicated by malondialdehyde (MDA) levels, was significantly reduced by MLT co-administration, demonstrating its antioxidant properties. LNG administration also reduced nitric oxide (NO) levels, which may have implications for neurotransmission and neuronal signaling. The observed changes in enzyme activities, such as G6PDH and AChE, further highlighted the potential neurochemical effects of LNG. These findings necessitate careful consideration of LNG's neurotoxic potential and the protective role of antioxidants like MLT. Comprehensive neurochemical assessments are crucial for ensuring the safety of contraceptive use, particularly in individuals with neurological vulnerabilities.

Quality Assurance in Contraceptive Use and Supplement Co-administration

The present study highlighted the importance of rigorous assessment and quality assurance in contraceptive use and supplement co-administration. The observed alterations in lipid profiles, oxidative stress markers, and enzyme activities, underscored the need for thorough safety evaluations.

Standardization of Assessment Protocols: The use of validated methods for biochemical and neurochemical assessments ensured the reliability and comparability of results. Standardised protocols are crucial for global research collaborations and evidence-based decision-making (Bolarinwa, 2015; OECD, 2005).

Ethical Considerations: The use of animal models necessitated dherence to ethical guidelines, ensuring humane treatment and responsible research practices. Ethical considerations are paramount in global research collaborations and knowledge dissemination

Supplement Co-administration: The protective effects of MLT highlighted the potential benefits of supplement co-administration in mitigating adverse effects. However, further research is needed to determine optimal dosages and long-term effects.

Clinical Implications: The findings of this study have significant implications for clinical practice and public health guidelines. Healthcare providers should be aware of the potential neurochemical and biochemical effects of LNG and consider individualized risk assessments.

Limitations and Future Directions

The interpretation of these results was subject to certain limitations, including the utilisation of an animal model that may not entirely recapitulate human physiological responses. Subsequent research should prioritise the evaluation of the long-term effects of concurrent LNG and MLT administration, as well as their impact on reproductive function and behavioural endpoints. Clinical trials in human subjects are warranted to validate these preclinical observations.

Globalizing Education and Research Standards

These findings highlighted the need for standardised assessment protocols in global research, ensuring consistency and comparability of results across different laboratories and regions (OECD, 2005).

Conclusion

The present study provided valuable insights into the neurochemical and biochemical safety of LNG in female Wistar rats. The findings highlighted, the potential adverse effects of LNG and the protective role of MLT co-administration. Rigorous assessment and quality assurance are crucial for ensuring the safety of contraceptive use and supplement co-administration. Future research should focus on validating these findings in human populations and developing evidence-based guidelines for clinical practice.

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Conflict of Interest

Authors have declared that no potential conflicts of interest exist.

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CHAPTER EIGHT

EdTech and Digital Equity: Strategies for Advancing Accessible, Affordable, and Sustainable Global Learning

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Abstract

This study investigated the role of educational technology (EdTech) in advancing digital equity by ensuring accessible, affordable, resilient, and sustainable global learning opportunities. Drawing on secondary data from a range of published sources, the research identified critical barriers to equitable EdTech adoption, particularly in rural and underserved regions. The study identified key challenges mitigating the were critical barriers to equitable EdTech adoption included inadequate internet connectivity, unreliable electricity, high costs, and limited digital literacy. These factors disproportionately affected learners from marginalised communities, hindering their access to quality education. The findings underscored the urgent need for collaborative efforts among stakeholders to develop and implement inclusive, AI-driven EdTech solutions that are both cost-effective and contextually relevant. Promoting digital equity requires not only technological innovation but also policy support, infrastructure development, and capacity building. This study advocates for a strategic, multi-stakeholder approach to harness EdTech's full potential in delivering equitable and sustainable education, especially for Generation Alpha and Generation Beta learners across diverse global contexts

Keywords: Digital Equity, EdTech, Education, Global Learning, Sustainable

Introduction

The convergence of education and technology, commonly framed as EdTech, has accelerated unprecedented transformations in the global learning landscape. While digital tools promise democratised access to quality education, a pressing dilemma continues to persist—digital equity**.** This refers not only to equitable access to technology, but also the capacity to meaningfully use it. In theory, the global shift toward online and hybrid

education should signify progress. In practice, it risks deepening existing educational disparities, especially in socio-economically marginalized communities.

The urgency of this issue became particularly apparent during the COVID-19 pandemic, which acted as a catalyst for digital learning adoption but simultaneously exposed stark infrastructural, economic, and pedagogical divides. As Hodges et al. (2020) emphasised, the global move to emergency remote teaching was not a testament to EdTech's readiness, but rather a reactive necessity. Indeed, the digital learning gap was laid bare, particularly in the Global South, where millions of students were left behind due to lack of internet, devices, and digital competence.

Recent scholarly inquiries have offered valuable insights into this inequality. Bulman and Fairlie (2021), analyzing educational access during the pandemic, argued that even in high-income nations, low-income students disproportionately suffered learning losses due to digital disadvantages. In contrast, countries with robust EdTech infrastructures, such as Finland or South Korea, maintained some degree of continuity (Kim & Rose, 2020). Yet, this disparity underscores a more fundamental question—are we mistaking digital availability for digital accessibility? To unpack this, one must confront the hidden architecture of digital learning: not just hardware or bandwidth, but pedagogy, local context, affordability, and sustainability. Selwyn (2021) cautioned against the techno-solutionist narrative that assumes technology inherently solves educational problems. Rather, he insisted that EdTech needs to be grounded in social realities and educational justice. Without such grounding, the promise of EdTech as a global equaliser remains an illusion.

Furthermore, the intersection of EdTech and policy frameworks remains under-explored. Warschauer and Matuchniak (2010) called attention to "second-level digital divides," focusing not on access but on how students engage with technology. Their work suggested that even when devices are available, inequities in teacher preparedness, content design, and institutional support can perpetuate inequality. In a similar vein, van Dijk (2020) argued that digital access without accompanying social support mechanisms does little to challenge educational stratification.

This study critically examined how EdTech can effectively function as a catalyst for promoting digital equity by ensuring universal access,

affordability, resilience, and sustainability in global education systems. It aimed to explore the extent to which educational technologies can transcend infrastructural limitations and foster inclusive learning environments across diverse socio-economic and geographic contexts. The investigation also delved into the broader sociotechnical ecosystems—including policies, pedagogical practices, and digital literacy frameworks—that shape the equitable implementation of EdTech solutions. Furthermore, the study interrogated potential strategic pathways, such as AI-driven interventions and stakeholder collaborations across public, private, and community sectors, that can support scalable and context-sensitive EdTech deployment without sacrificing quality or equity. Ultimately, this research aspired to identify actionable strategies for advancing cost-effective and resilient educational models that serve both current and future generations globally. Grounded in secondary data from Indian academia—a diverse educational ecosystem that captures both the promise and pitfalls of digital learning, this study explored a multi-scalar view of EdTech: from national policy down to village classrooms. India serves as a microcosm of global digital education challenges. Its demographic dividend, linguistic heterogeneity, and rural-urban digital divide present a fertile terrain for examining both failures and future pathways.

The concept of sustainability also takes center stage in this inquiry. Too often, EdTech interventions are measured by their novelty rather than longevity. Al-Azawei, Serenelli, and Lundqvist (2016) highlighted that sustainable e-learning systems must align with user needs, technological ecosystems, and pedagogical goals. Sustainability is not simply about enduring platforms; it is about adaptive models that thrive under evolving socio-economic conditions. This is particularly relevant as we design learning environments for Generation Alpha and Beta—digital natives with evolving cognitive patterns and educational expectations.

As Kozma (2005) asserted, the transformative potential of ICT in education depends largely on how it is integrated into EdTech curricula, teacher practices, and institutional planning. This view complements more recent frameworks of EdTech for equity (Pimmer, Mateescu, & Gröhbiel, 2016), which argued that inclusivity must be engineered into systems, not retrofitted. This study did not merely catalogue technological tools or digital platforms. Instead, it interrogated the systemic conditions under which EdTech can become a truly equitable force. Through empirical insights from academic

practitioners, policy frameworks, and cross-national literature, the study aimed to construct a nuanced narrative that recognises digital equity not as a byproduct of EdTech, but as its ultimate test.

Review of Literature

Katz and Levine (2015) investigated digital equity among Hispanic families in the U.S., revealing that while devices and connectivity were increasing, meaningful access depended heavily on cultural context and parental digital literacy. Their mixed-methods study uncovered how language barriers and limited understanding of educational platforms hindered actual engagement, despite the presence of hardware and basic internet access. Basham, Stahl, Ortiz, Rice, and Smith (2015) analysed K–12 online learning for students with disabilities, documenting early evidence that online environments often failed to meet the specialised needs of learners with IEPs. Their exploratory work questioned whether online systems offered sufficient accommodations, prompting calls for more targeted support designs for equitable educational outcomes. Warschauer and Matuchniak (2015) provided a foundational review in *Review of Research in Education*, arguing that achieving equity in EdTech required advancing from simple device distribution to integrating pedagogical strategies, teacher training, and curriculum redesign. They emphasised that access must be accompanied by effective usage—an idea that became a recurring theme in digital equity discourse.

The Center on Online Learning and Students with Disabilities (2016) (the "Equity Matters" report) synthesised research on virtual and blended education for differently-abled students or students with disabilities. It traced structural strengths and weaknesses across U.S. states, calling for clearer policies, enhanced teacher preparation, and better-designed online platforms to ensure equity in both access and educational outcomes. Selwyn and Facer (2016) critically examined the EdTech agenda in *Learning, Media and Technology*, challenging the assumption that more educational technology naturally leads to improved equity. They highlighted how market-driven models often neglected the complexities of socio-economic and cultural contexts, suggesting that equitable EdTech required more than just scaling devices—it needed systemic rethinking. Trucano and Kozma (2016) assessed over 40 national-level digital learning initiatives, arguing that infrastructure investments often failed when they didn't align with linguistic, pedagogical,

and curricular realities. Their policy-oriented study concluded that strategic planning, capacity building, and locally relevant content were critical to turn device distributions into effective learning opportunities.

Moore and Vitale (2017)**,** through a large-scale survey for ACT, documented persistent inequities related to device access and connectivity among secondary school students. They emphasised policy measures such as subsidised internet and stronger mobile access to address a "homework gap" exacerbating rural and low-income learning challenges. MIT Initiative (Klein, 2017) reaffirmed that despite ubiquitous devices and mobile broadband, deep divides remained, especially between rural and urban, and wealthy versus underprivileged regions. Their analysis reinforced that infrastructure alone was insufficient without complementary educational programmes and equitable policies. Bishop and Lee (2017) proposed equity-centered approaches to EdTech in the *Handbook of Research in Educational Communications and Technology*. They outlined how intentional design could support historically marginalised learners, emphasising the inclusion of equity perspectives in all stages of educational technology development.

Moore and Vitale (2018) revisited the "homework gap," this time with national survey data, describing it as a systemic barrier where device access in schools didn't translate to home learning capability. Their policy analysis pushed for a reimagining of broadband as essential infrastructure, akin to electricity and water, and called on governments to subsidise or regulate internet provision as a public good. Hanover Research (2018) provided district-level case studies showing how technology integration often failed due to lack of teacher training, inadequate digital literacy, and rigid curricula unsuited for blended learning. Their findings advocated for holistic technology strategies addressing pedagogy, professional development, and content redesign. ACT (Moore & Vitale, 2018) further emphasised that equitable access required reliable connections, multi-device availability, and support across home and school, along with policies to ensure underserved students weren't left behind.

Nakayama et al. (2019) conducted a study in Brazil analysing digital inclusion for rural youth. They found that infrastructural improvements alone did not reduce inequities—effective outcomes depended on localised educational interventions, teacher training, and culturally relevant content. Education

without community engagement failed to shift persistent disparities. Dimaggio, Hargittai, Celeste, & Shafer (2019) examined second and third-level digital divides—access, skills, and usage among U.S. adults. Their large–scale survey revealed that income, education, age, and ethnicity were powerful predictors of digital engagement, shaping the quality and outcome of technology-mediated learning experiences.

Reimers and Schleicher (2020), in a global OECD report on COVID-19 responses, highlighted that robust EdTech preparedness correlated with minimal learning disruptions during school closures. However, equity was not assured; marginalised learners in under-resourced communities suffered greatest losses, underscoring that infrastructure must be paired with equity strategies. UNESCO (2020) documented that 40–65% of schools globally lacked adequate connectivity. They argued device distribution schemes often failed due to absent teacher training and curriculum alignment, calling for comprehensive digital education frameworks that emphasise equity and teacher capacity.

Cruz (2021) studied Indian rural-urban EdTech disparities, documenting how women and rural students faced compounded barriers in access and engagement. Her qualitative data revealed social norms, device sharing, and unreliable internet combined to disproportionately limit their learning opportunities. Bulut et al. (2021) explored algorithmic fairness in AI-based educational measurement. They concluded that without rigorous ethical frameworks, AI tools could perpetuate biases and further marginalize underrepresented students, even as they offered scalable assessment potential.

Chaudhry, Cukurova and Luckin (2022) developed a Transparency Index for AI EdTech, co-designed with educators and technologists. They emphasised that ethical, equitable AI requires transparency across data sources, model processes, and decision-making, crucial to ensuring trust and fairness in educational contexts. Fenu, Galici and Marras (2022) conducted interviews with EdTech AI experts, identifying fairness, accountability, and representativeness as key challenges. They urged for standardised auditing mechanisms to detect and correct algorithmic bias before deployment in classrooms.

Gillani, Eynon, Chiabaut & Finkel (2023) issued a clarifying essay on AI in education’s 'black box.' They advocated demystifying AI, defining terms,

methods, and limitations, to empower educators, administrators, parents, and learners to engage critically and prevent unchecked adoption. D'Agostino (2023) analysed the emerging "AI literacy divide" in higher education. She argued that students with decentralised access to AI tools developed prompt-engineering skills while others fell further behind, reinforcing that equitable educational ecosystems must include AI literacy and support as fundamental components, not optional add-ons.

Liu et al. (2024) examined generative AI integration in schools, warning that tools like ChatGPT often neglect non-Western cultures and languages. They recommended policies that mandate translation support, diverse cultural training datasets, and subsidised access to high-quality AI platforms for all learners. OECD (2024) released guidelines stressing four pillars of AI equity in education: universal access to connectivity, AI literacy among teachers, transparent ethical standards, and quality assurance in AI tool deployment. They explicitly linked these pillars with the UN Sustainable Development Goal 4 for inclusive education.

Graf, Peng & Dumitru (2025) presented empirical evidence that AI-based adaptive programming education significantly improved learning outcomes and engagement among socioeconomically disadvantaged students. Their real-world implementation demonstrated that personalised, responsive learning pathways could reduce performance gaps. Chasokela and Sithole (2025) explored AI's role in sustainable development education. They emphasised that AI tools must be equity-centered from design to assessment, aligning pedagogical goals with social justice and global competencies. Loble and Stephens (2025) proposed an Australian Digital Equity Guarantee, conceptualising AI and EdTech policy through four equity dimensions: access, data, design, and effective use. Their framework offers a model for system‑level integration of digital equity in national education strategies.

Research Gaps

While the extant literature has significantly expanded our understanding of educational technology (EdTech) and its role in shaping learning outcomes globally, several critical gaps persist, particularly when viewed through the lens of digital equity. Numerous studies from 2015 to 2025 have highlighted disparities in access, infrastructural limitations, and algorithmic bias, yet they often approach these issues in isolation. There remains a noticeable deficiency

in integrative research that examines EdTech as a multifaceted ecosystem, where infrastructure, pedagogy, governance, digital literacy, and cultural relevance must operate in concert to ensure equity and sustainability.

Most existing scholarship has concentrated on either technological deployment or digital access metrics (e.g., broadband penetration, device availability). However, few have deeply investigated how these tools intersect with localised sociotechnical systems—such as teacher competencies, community-level policy adaptations, and the socio-cultural dimensions of digital literacy. This leaves a gap in understanding how context-sensitive and pedagogically aligned EdTech solutions can be scaled while maintaining affordability and resilience across diverse learning environments.

Additionally, although international organisations like UNESCO and OECD have provided frameworks for equitable technology integration, there is insufficient empirical research on the collaborative roles of public, private, and civil society actors in creating sustainable EdTech infrastructures. Questions remain about how these stakeholders can align incentives, resources, and responsibilities to produce scalable and high-quality educational experiences that do not reinforce existing hierarchies.

Emerging technologies—such as AI-driven learning platforms—have not yet been comprehensively evaluated for their long-term equity outcomes, particularly in low-resource settings. Much of the current work focuses on AI's capabilities rather than its social consequences. This highlights a major gap in investigating inclusive design, participatory deployment, and ethical governance as central components of educational AI systems. Thus, this study addressed the unmet need for a holistic inquiry into how EdTech can be deliberately designed and collaboratively implemented to foster digital equity, not only through improved access, but also through structural transformation of educational delivery models across the globe.

Research Objectives

- To explore how EdTech can be leveraged to promote digital equity by ensuring universal, affordable, and resilient access to education across diverse global contexts.

- To examine the sociotechnical systems, including infrastructure, pedagogy, policy, and digital literacy, that influence the equitable and sustainable implementation of educational technologies.
- To identify scalable strategies and collaborative models involving public, private, and community stakeholders that can deliver cost-effective, high-quality, and context-sensitive global learning solutions.

Research Methodology

Secondary data-based research methodology refers to the process of systematically collecting, analysing, and interpreting information that has already been generated, published, or archived by other researchers, institutions, or organizations. This approach is particularly valuable in studies that aim to explore broad, complex, or global phenomena, such as digital equity in education, where direct primary data collection may be constrained by time, geography, or resources. In the context of this study, which investigated the role of EdTech in advancing accessible, affordable, and sustainable global learning, secondary data serves as a foundational tool for contextual understanding and comparative analysis. The methodology began with identifying credible and relevant sources from peer-reviewed journals, reports, and other published work. Special attention was paid to the credibility, timeliness, and scope of the data, ensuring that the literature spanned a decade and covered wide perspectives. These data sources included empirical studies, policy evaluations, conceptual frameworks, etc. related to EdTech deployment and digital equity. The secondary data was then thematically organised and synthesised, aligning with the key research objectives. A key strength of secondary data research is its ability to draw on large-scale, cross-cultural, or long-term datasets that would be challenging to replicate through primary methods. However, this approach also necessitates caution in terms of contextual relevance, data currency, and the original intent of the collected information.

Data Analysis

Objective 1: Access, Affordability and Equity

- **Device and Internet Access**

The Annual Status of Education Report (ASER, 2022) documented that rural households in India have access to a smartphone, but have reliable internet

connectivity issue-that have improved post-pandemic. Government evaluations of Edtech platforms show that while platform adoption increased during COVID-19, actual active usage remained low in some states (National Education Policy 2020).

- **Affordability constraints persist:**

The Telecom Regulatory Authority of India (TRAI, 2023) revealed that despite competitive data pricing, 1 GB monthly plans remain a burden for families earning <₹10,000 per month. As Sharma and Rao (2021) argued, the affordability gap is as much social as economic; even when devices are technically accessible, costs of maintenance, electricity, and data limit sustainable engagement.

- **Resilience of Learning Systems**

UNESCO-Delhi's 2021 report highlighted how EdTech initiatives in some states maintained educational continuity during crises thanks to hybrid models blending radio, SMS, and student volunteer networks. In contrast, schools in other states reported abandonment of digital teaching after four months due to lack of infrastructure and training (UNESCO, 2021). A study by Kumar et al. (2022) also found that solar-powered labs helped improve EdTech resilience in remote districts, countering frequent blackouts and supporting offline-capable e-content. These local interventions align with global best practices on resilient education systems (Reimers & Schleicher, 2020).

Objective 2: Sociotechnical Systems Analysis

Infrastructure & Platform Readiness

Data from the Ministry of Electronics and Information Technology (MeitY) in 2022 showed that not every government and private schools have functional computer labs with internet connectivity. Evaluations of EdTech platforms revealed intermittent updates, engagement and interaction level with little integration into mainstream curriculum (Prakash & Mehra, 2020). Research by Singh and Joshi (2023) confirmed that EdTech adoption is highest in states where robust platforms align with syllabus, training, support, and localized content.

- **Pedagogical Integration & Teacher Preparedness**

NEP 2020 directs training all educators in digital pedagogy, yet NCTE (2021) reports indicated that teacher-training institutions are offering competency-based ICT programmes. Vidyarthi & Sinha (2022) observed that teachers view digital tools more as administrative aids and less as pedagogical enhancers—mirroring findings from global literature about passive rather than active integration (Hill & Sharma, 2020). Case studies of EdTech platforms revealed success when teacher training is continuous and contextual, with district-level mentorship and peer learning. The ASER Learning Barometer (2023) reported a marked improvement in digitally facilitated learning following training interventions.

- **Policy Implementation & Governance Networks**

While NEP 2020 outlined digital equity goals, lack of operational coordination hinders results. A 2023 Comptroller & Auditor General (CAG) report criticised bottlenecks such as delayed content localisation, platform interoperability issues, and low teacher compliance. Gujarat Recharge Model and Karnataka's Smart Classrooms programme are frequently cited as contrasting successful examples of decentralised decision-making and civil society engagement (Desai & Patel, 2022).

- **Digital Literacy Among Students and Communities**

Rural digital literacy is low; however, students in different states can navigate online assessments independently, although girls and boys have some socio-cultural constraints (Kumar & Singh, 2021). National literacy campaigns showed improved basic usage and addressed critical pedagogical literacy and language proficiency (Mehrotra, 2022).

Objective 3: Scalable Collaborative Models

Public–Private Partnerships

Public–Private–NGO partnerships are gaining traction. Tata Trusts' ClassEdge partnered innovatively with state governments to provide curriculum-integrated EdTech, achieving increasing usage in different states (Tata Trusts, 2022). Similarly, Microsoft's 'Project Nanhi Kali' demonstrated success in supplementing state efforts with locally relevant teacher training and device provision (Microsoft India, 2023).

- **Community-Led Initiatives**

Community-driven projects utilise student ambassadors, parent-teacher committees, and local NGOs to run digital labs. NGO-led evaluations (PRADAN, 2022) showed that community-anchored models increase both usage and content relevance, leading to higher student engagement.

- **Customisable and Localised Platforms**

Some EdTech platforms allow states to customise content; many states have developed regional courses. The localised approaches align with global observations that top-down EdTech fails without flexibility (UNESCO, 2022).

Emerging Technologies & Opportunities

- **AI in Education**

Research by Srivastava (2023) showed AI chatbots in English and Hindi improved learning in selective schools. Yet, the lack of regional-language AI and concerns about cultural bias limit broader adoption.

- **Mobile Learning**

Study indicated that rural families share at most one smartphone among four individuals (TRAI, 2023). While WhatsApp-based learning is ubiquitous, content overload and lack of interactivity limit its effectiveness. A study by Verma and Rao (2022) suggested that low-cost mobile strategies must balance interactivity with bandwidth limitations.

- **Open Educational Resources (OERs)**

National Digital library has very good assets. However, Prakash and Mehra (2020) noted that routine usage by all teachers is an issue due to relevance or lack of training. Localisation could improve usage (ASER, 2023).

Strategic Insights

- Equity requires multi-tiered investment: digital access, training, local content, and governance.
- Localised EdTech design is essential to equitable scale.
- More community engagement can enhance both access and use.
- Emerging tech like AI and OER must be adapted for low-resource settings.

- Capacity building and policy implementation remain under‑resourced links in the EdTech ecosystem.

Findings and Discussion

Digital Equity: Access, Affordability, and Resilience

Affordability as a Core Barrier

ASER (2022) illustrated that there is increasing use of smartphone in rural Indian households but have consistent internet access issue. This lack of affordability, confirmed by TRAI (2023) findings on data costs, directly undermined the first research objective. It showed that even with policy initiatives to distribute devices, recurring expenses—data, repairs, electricity erode sustained use. This supports the literature (Selwyn & Jandrić, 2022) emphasising that EdTech equity demands more than short-term funding; it needs long-term subsidies and cost-sharing models.

- **Resilience: Beyond Device Distribution**

The study highlighted that while some regions built resilient learning systems, others lost momentum once short-term funding ended. Local solutions such as solar labs (Kumar et al., 2022) illustrate effective technical resilience but require integration with teacher training and content localization for long-term impact. This triangulates with UNESCO's findings on hybrid learning approaches and affirms that resilience is an ecosystem—not just hardware.

Sociotechnical Systems: Infrastructure, Pedagogy, Policy, and Digital Literacy

- **Infrastructural Readiness**

Minimum digital infrastructure standards in each and every school is a matter of concern. Secondary reports (MoE, 2020; MeitY, 2022) and Singh and Joshi (2023) showed uneven state-level distribution of ICT capacity. These structural gaps impede objective two by blocking meaningful EdTech integration. Digital divide analysis indicates that policy emphasis should shift from procurement of devices to sustainable ICT infrastructure development in all schools.

Pedagogical Integration Clauses

Significant disparity exists between policy aspiration and ground-level pedagogy (NCTE, 2021). Teachers largely employ EdTech as an administrative convenience, not as an interactive instructional tool (Vidyarthi & Sinha, 2022). District-level mentorship programme, in contrast, demonstrates that structured, context-sensitive professional development can transform EdTech usage.

Policy Execution Gaps

NEP 2020 and digitisation goals are ambitious, yet as the Comptroller & Auditor General (2023) highlighted, content localisation, interoperability, and teacher involvement remain a question. Successful states share traits: decentralized decision-making, routine monitoring, and civil-society integration. These observations align with Reimers and Schleicher (2020), who argue that agility and local ownership are key success drivers.

Digital Literacy and Equity

Digital literacy-especially among girls and low-income students—remains severely limited (Kumar & Singh, 2021). Utility of EdTech platforms is hampered by literacy barriers. The disadvantage results from device-sharing norms and patriarchal constraints. National literacy programs improve basic digital use but overlook critical pedagogical and language aspects (Mehrotra, 2022). These findings affirm that digital literacy is not just technical fluency—it is about functional, critical, and cultural competency.

Scalable and Collaborative Models

- **Public-Private Partnership Effectiveness**

Tata ClassEdge and Microsoft's Project Nanhi Kali highlighted how PPPs can scale while maintaining local relevance. They mobilise state infrastructure—schools, teachers—with private expertise—tech solutions, capacity-building. These models outperform wholly public or private interventions by combining stable funding with innovation and community trust, fulfilling Objective 3.

- **Community Ownership**

Projects in different states show stronger engagement where communities manage labs, content, and troubleshooting. Community-anchored EdTech is more sustainable and usage-intensive. These align with global insights from

UNESCO (2022) stressing the importance of local adaptation and bottom-up governance.

- **Localisation and Customization**

DIKSHA's multi-language capabilities, and successful localization, underscore the importance of curricular contextualization. Such approaches mitigate the risk of "curriculum monoculture." But execution irregularities suggest that customization capabilities must be institutionalized within national platforms for uniform accessibility.

Regional & Contextual Disparities

- **Urban–Rural and State-Level Inequities**

Data highlights stark divides: some states are excelling in EdTech integration, while others lag substantially across all performance metrics. This regional inequity demonstrates the need for policy specificity and decentralised implementation strategies that respect local contexts.

- **Socio-Cultural Barriers**

Patterns such as gendered device sharing and reluctance toward digital learning point to socio-cultural inhibitors not fully captured in infrastructure investments. These must be addressed via targeted inclusion strategies - e.g., mobile labs for all students, safe community spaces for device access, mentorship programmes, etc.

Emerging Technologies: Opportunity and Oversight

- **AI-Powered Learning**

Early implementations, such as chatbots for primary education show promise but stress the need for culturally aware, linguistically inclusive models. As predicted in literature, algorithmic bias and language exclusivity limit equitable outcomes unless equity is embedded in system design.

- **Mobile Learning in Rural Contexts**

With high mobile penetration but low device ownership per individual, mobile-first EdTech strategies must account for multi-user usage, shared data

constraints, and limited content interactivity. Low-cost voice and SMS solutions offer promising approaches.

- **Open Educational Resources (OERs)**

DIKSHA's vast repository provides accessible educational content, yet an utilisation rate is a matter of concern. Teacher training, curricular embedding, and content localisation are required to transform OERs into usable classroom resources.

Strategic Insights

- **Multi-Tiered Investment Strategy**

Findings stressed that digital equity demands investment beyond procurement. Infrastructure, teacher training, content localisation, community engagement, and governance instruments must be funded and coordinated across government tiers.

- **Localisation as a Core Principle**

Customization—linguistic, cultural, pedagogical- must be embedded into platform architecture and policy frameworks. Local stakeholder participation enhances ownership, usage consistency, and learning outcomes.

- **Strengthening Digital Literacy**

Digital skill-building must include critical, cultural, and language dimensions. EdTech Programmes should pivot to advanced, equity-related literacy modules and target marginal groups with specialized outreach.

- **Regulation and Equity Governance**

Emerging EdTech sectors—AI tools, OER repositories-require built-in equity standards, algorithmic audits, and transparent governance to prevent replication of offline disparities.

Conclusion

The evolving landscape of education in the 21st century is deeply interwoven with the rise of educational technologies (EdTech), especially in the context of ensuring digital equity. As this research set out to explore, EdTech holds

remarkable potential to democratise learning across geographies, socioeconomic divides, and cultural contexts. However, its transformative power is not inherent-it must be intentionally harnessed through thoughtful design, inclusive policy frameworks, and collaborative implementation models. This study, grounded in extensive secondary data analysis, has illuminated both the promise and the persistent limitations of EdTech in achieving truly accessible, affordable, and sustainable global learning.

The first research objective—to understand how EdTech can be leveraged to ensure universal, affordable, and resilient education—revealed a complex matrix of challenges and opportunities. While significant efforts have been made at national and state levels to distribute digital devices, improve internet infrastructure, and provide open educational resources, these efforts remain unevenly distributed and inconsistently adopted. Affordability continues to be a central barrier, particularly in rural and economically marginalized communities. Although smartphone penetration has grown, device sharing and data affordability issues limit effective access in groups. Moreover, resilience in EdTech systems requires more than hardware; it demands robust support mechanisms, technical training, and localized content that evolves with pedagogical needs and technological advancement.

The second objective focused on the sociotechnical systems—policy, pedagogy, infrastructure, and digital literacy—that shape equitable and sustainable implementation. The study affirmed that infrastructure alone does not guarantee educational impact. Digital equity is intrinsically tied to the quality of interaction between users (students, teachers), tools (platforms, devices), and systems (curriculum, evaluation). The National Education Policy (2020) rightly emphasised digital inclusion, but actual deployment across states is hampered by fragmented governance, inadequate monitoring, and insufficient teacher preparation. Teacher digital fluency remains a weak link in the chain, not just in terms of basic tool usage, but in integrating EdTech meaningfully into instructional strategies. Furthermore, while some private platforms and government initiatives have made strides in content development, the lack of linguistic, cultural, and regional localization significantly dilutes the inclusivity and efficacy of EdTech interventions.

A key insight drawn from the study is the limited scope of digital literacy programmes in addressing the deeper, structural inequities embedded within

the digital learning ecosystem. Literacy is too often narrowly defined as operational proficiency—navigating a device or opening an app—whereas true digital equity requires critical digital skills: the ability to evaluate content, participate meaningfully in virtual learning spaces, and exercise agency in one's own educational journey. Moreover, cultural biases, algorithmic invisibilities, and gendered restrictions on device access further complicate the equity landscape.

The third objective-identifying scalable, collaborative models- emerged as one of the most fertile areas for innovation and policy intervention. Multi-stakeholder partnerships, especially those involving public institutions, private technology providers, NGOs, and local communities, have shown considerable potential in extending reach and contextual sensitivity. Projects that embed communities as co-creators, not just beneficiaries, of digital solutions tend to enjoy higher sustainability, relevance, and local ownership. Initiatives like mobile learning buses, community EdTech facilitators, and hybrid learning hubs serve as practical, scalable models that can be tailored to different geographies and learner profiles.

In the Indian context, the diversity of EdTech landscapes across states illustrates the critical importance of decentralised, context-responsive policy approaches. While some states have leveraged strong governance and public-private synergies to build robust digital ecosystems, some lag behind due to bureaucratic inertia, underinvestment, or lack of grassroots engagement. This disparity underscores the need for national frameworks that are flexible and adaptive, allowing for innovation at the local level while maintaining coherence and quality assurance.

What also became evident is the untapped potential of emerging technologies like Artificial Intelligence (AI), adaptive learning systems, and gamification. When thoughtfully implemented, these tools can personalise learning, track learner progress, and make education more interactive and engaging. However, they also introduce new ethical and equity concerns—bias in AI algorithms, data privacy issues, and the risk of further marginalising digitally unprepared learners. Thus, any advancement in EdTech must be coupled with rigorous regulatory oversight and inclusive design principles that centre the learner's context and rights.

This study reaffirmed a core truth: technology alone cannot resolve educational inequities. It must be embedded in a larger human-centred framework that prioritises equity, dignity, and meaningful participation for all learners. EdTech is not a silver bullet, but a powerful tool that, when guided by inclusive principles and localised strategies, can expand the reach, relevance, and resilience of global education systems.

The implications of these findings are both urgent and optimistic. As we move further into an era defined by digital disruption and generational shifts—especially with the rise of Gen Alpha and Gen Beta—there is a critical window of opportunity to shape a more equitable educational future. Policymakers must go beyond infrastructure funding and develop robust strategies for content localization, teacher training, and digital citizenship education. Technology companies must design with empathy and inclusivity in mind, prioritizing low-bandwidth, multi-language, and offline-compatible solutions. Academic institutions and civil society must act as bridges-translating global innovations into locally grounded interventions that are relevant, effective, and empowering.

The study offered a comprehensive lens on the potential and pitfalls of EdTech in promoting digital equity. By illuminating the structural, pedagogical, and collaborative dimensions of equitable EdTech ecosystems, the study not only addressed critical research gaps but also provided actionable insights for diverse stakeholders. A globally connected, digitally inclusive education system is not a distant dream—it is a deliberate project that demands vision, collaboration, and sustained commitment from all actors involved.

Future Implications

As digital learning becomes increasingly central to global education systems, especially in the post-pandemic world, it is imperative that future policies surrounding EdTech and digital equity evolve beyond short-term infrastructural goals to more holistic, inclusive, and sustainable frameworks. The insights gained from this study suggest several key policy directions:

- **Equity-Centered Design in EdTech Policies**

Governments must develop policies that embed equity as a foundational principle—not as an afterthought. This involves mandating universal access to

basic digital infrastructure (devices, internet, electricity), but also ensuring affordability through subsidies, community resource centers, and low-cost public technologies. Policies must be targeted at the most digitally excluded groups, including rural learners, tribal communities, persons with disabilities, and especially girls, who often face intra-household digital restrictions.

- **Localised and Multilingual Content Development**

A significant policy gap lies in the lack of culturally relevant, linguistically diverse, and curriculum-aligned digital content. Future policy must prioritise regional content development through local partnerships with educational institutions, NGOs, and grassroots innovators. EdTech platforms should incorporate regional boards, student voices, and teacher feedback into iterative content design.

- **Institutional Support for Teachers' Digital Readiness**

A digitally enabled classroom is only as effective as the teacher's ability to facilitate it. Future policy frameworks should make digital pedagogical training a mandatory component of teacher education. Continuous professional development programmes must be decentralised, contextually appropriate, and incentivised through career progression pathways.

- **Public-Private-People Partnerships (PPPP)**

To scale EdTech solutions while preserving quality and inclusivity, governments must craft collaborative policy ecosystems that include private sector innovation, public education infrastructure, and civil society's community knowledge. Future policies should support blended models that combine online platforms with offline, community-based learning hubs. Regulatory guidelines should ensure private sector accountability in terms of data privacy, affordability, and learner inclusivity.

- **Resilience-Oriented Digital Infrastructure Planning**

Post-pandemic, the concept of educational continuity in emergencies must be embedded into national education plans. Policies must support the creation of hybrid and asynchronous models that are resilient to disruptions (pandemics, natural disasters, conflict zones). Battery-operated devices, solar-powered

learning kiosks, and offline learning apps should be integrated into disaster management education policies.

- **Monitoring, Data, and Feedback Loops**

A lack of reliable and disaggregated data continues to hamper effective EdTech policy implementation. Future policy must invest in data systems that monitor EdTech usage, learner outcomes, digital exclusion patterns, and teacher capacity. However, such data must be used ethically, avoiding surveillance or punitive approaches, and instead promoting a continuous improvement cycle.

Limitations of the Study

Despite the comprehensive scope of this study, certain limitations must be acknowledged to contextualise the findings and recommendations. First and foremost, the research relies on secondary data, drawing from published reports, academic journals, policy documents, and publicly available databases. While this allows for a broad analytical perspective and helps capture established trends in EdTech and digital equity, it inherently lacks the depth and immediacy of real-time field data. The absence of rich primary data, especially from underserved communities, limited the ability of this study to capture the nuanced, lived experiences of learners and educators who are most affected by digital exclusion. Additionally, the study, though global in intent, had a strong country-centric focus. This geographic emphasis was deliberate, as it represented a large and complex educational ecosystem with diverse EdTech experiments and digital inclusion policies. However, this focus also restricted the generalisability of the findings to other national contexts, particularly those with different political, economic, and infrastructural realities. While some strategies discussed may resonate with other countries, cultural, policy, and infrastructural differences should be taken into account when applying the insights elsewhere.

Another limitation stemmed from the absence of quantitative primary research. The study did not incorporate large-scale surveys or statistical models to validate the patterns and challenges identified in the secondary sources. Quantitative data on the actual usage patterns, learning outcomes, and engagement levels with EdTech across different socioeconomic strata could have strengthened the empirical foundation of the conclusions. Future research would benefit from mixed-method approaches that combine the

breadth of secondary data with the depth and rigor of field-based quantitative and qualitative assessments.

Furthermore, the rapid evolution of technology presents a temporal challenge. The EdTech landscape changes swiftly—platforms, pedagogies, and policies often undergo significant transformations within short timeframes. As such, there was a natural time-lag between data collection, analysis, and publication, which might render some insights less applicable by the time they reach policymakers or practitioners. This dynamic nature of technology should necessitate continual research updates and iterative policy frameworks.

Lastly, despite efforts to analyse inclusive strategies, the study might have inadvertently underrepresented the voices of the most marginalised groups—such as children with disabilities, indigenous learners, and migrant families. These populations often face unique digital and cultural barriers that mainstream data sources do not adequately capture. Without their active participation in research processes, there is a risk of reinforcing generalised solutions that fail to address specific, intersectional vulnerabilities. Thus, future studies must adopt participatory and ethnographic methods to bridge this gap and ensure that digital equity frameworks are truly inclusive. While the current research provided a critical foundation for understanding how EdTech can foster digital equity in education, these limitations ed the need for further, ground-level, interdisciplinary, and intersectional inquiry.

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CHAPTER NINE

Patient's Expectation Factor on Drug Dispensing Pattern of Patent and Proprietary Medicine Vendors in Kwara State, Nigeria

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Abstract

This study assessed the effect of patient's expectation on drug dispensing pattern of PPMVs. The study was a cross-sectional study design among randomly selected 389 PPMVs. A mixed (quantitative & qualitative) method of data collection was used. Data were collected, collated and analysed using Statistical Product and Service Solutions (SPSS, version 28.0), and the level of significance was set at $p < 0.05$. The majority (89.5%) of respondents reported that patient expectations moderately influenced their dispensing habits, and only a small percentage 6.9% felt patient expectations had little to no influence on their dispensing pattern. This is further buttressed by the Key Informant Interview with some of the PPMVs. The study further revealed that patient demand, among other factors such as peer pressure, financial incentives and regulatory pressure, acts as a barrier to appropriate dispensing. The vast majority (85.1%) of respondents considered patient demand for a specific drug as a moderate barrier to a more rational dispensing. Therefore, this study showed that patient pressure is a significant factor influencing the drug dispensing pattern of PPMVs. The study recommended the creation of enlightenment programmes on rational drug use starting at the grassroots level, and encouragement of care-seeking and consultation.

Keywords: Patient's expectation, Drug dispensing Pattern, PPMVs, Kwara,

Introduction

In many low- and middle-income countries, the private sector provides a significant portion of healthcare services. In Sub-Saharan Africa, around half of all child health services are provided by private providers, which range

from traditional healers and informal providers to privately owned specialty hospitals. In particular, drug shops account for between 15% and 83% of all child health services and make up a sizeable portion (nearly 40%) of the region's private healthcare sector. Several countries in Sub-Saharan Africa have included private drug retailers in national health interventions to address the role of the retail drug sector.

A primary supply of medication for acute ailments in Nigeria is owner-operated drug retail businesses, often known as patent and proprietary medicine vendors (PPMVs). According to national studies, PPMVs treat between 8% and 55% of diseases in children under five as their primary care provider. Similar findings have been made by community- and state-level research on care-seeking behavior: PPMVs treat between 35% and 55% of adults seeking treatment for malaria and are the initial point of care for up to 55% of diseases affecting children under the age of five (Beyeler et al., 2015).

There is no formal training need for PPMV licensing in medicine or pharmacy. Instead, a lot of PPMVs do an apprenticeship under a more experienced PPMV before starting their own business, and they are often expected to have finished elementary school. The National rules allow PPMVs to provide a restricted range of pre-packaged, over-the-counter pharmaceuticals and medical supplies, but they are not allowed to perform invasive medical procedures (such as injections) or sell prescription drugs, including antibiotics.

In the context of patent and proprietary medicines vendors (PPMVs) in Nigeria, drug dispensing refers to the process by which these vendors, who are not licensed medical professionals, issue medications or drugs to patients.

Ensuring that everyone has access to high-quality healthcare services regardless of where they reside is known as Universal Health Coverage (UHC). Many nations, including Nigeria, have made achieving UHC a top goal. To do this, they must make the most of the material and human resources that the public and private sectors have to offer. The private sector is a major player in the delivery of health care in many resource-poor nations, such as Nigeria, where it serves a sizeable section of the populace.

For instance, the 2018 Nigeria Demographic and Health Survey (NDHS) revealed that 33% of women gave birth in an institution and 41% of users obtained contemporary contraception from the commercial sector. Treatment

for pediatric diseases was sought by 62.3% of children under five who had fever, 63.5% who had diarrhea, and 50.5% who had acute

The proprietary vendors, popularly referred to as patent and proprietary medicine vendors (PPMVs), is defined as "individuals without formal pharmacy training selling orthodox pharmaceutical products on a retail basis for profit," are notable members of Nigeria's private sector. An estimated 200,000 PPMVs exist in Nigeria. For most Nigerians, PPMVs serve as the first line of treatment, offering family planning, treatment for malaria, diarrhea, pneumonia, and other illnesses, and tending to both adults and children, particularly in rural areas.

The PPMVs also have many qualities that appeal to members of the community such as long opening hours, hospitability, and more consistent availability than public facilities that frequently experience service interruptions. Given their widespread presence, well-regulated and well-trained PPMVs could boost Nigeria’s progress towards UHC by being more involved in promising health interventions such as integrated community case management (iCCM) (Oyeyemi et al., 2020).

The development of antibiotics has fundamentally changed healthcare delivery and reduced the global morbidity and mortality rate from infectious diseases. However, the global emergence of antimicrobial resistance organisms (AMRO) and the accompanying difficult-to-treat infections, prolonged hospital stays, higher healthcare costs, and worse health outcomes are the result of, among other factors, microbial evolution, antibiotic misuse, and inadequate infection control practices. Developing nations in Asia and Africa are most vulnerable to the growing global danger posed by antibiotic resistance. If nothing is done to stop the rising trend of antimicrobial resistance (AMR), it is predicted that by 2050, 10 million people worldwide each year—roughly 4 million in each of Asia and Africa—will pass away from AMR (Achi et al., 2021).

PPMVs are legally allowed to offer a restricted quantity of pre-packaged Over-The-Counter (OTC) medications.Although formal training in medicine or pharmacy is not necessary for a PPMV license, most PPMVs do an apprenticeship with a more experienced member of the profession before opening their store. Conventionally, the minimum educational level has been primary schools. Customer demand frequently determines the goods and

services offered by PPMV shops since their main purpose is retail sales rather than healthcare, which could result in PPMVs operating outside of their legal boundaries (Prach et al., 2015).

PPMVs offer medications and services for a wide range of health needs, such as tuberculosis, respiratory infections, diarrhea, malaria, common colds, and reproductive health, but the quality of these treatments is poor, according to a recent comprehensive evaluation of PPMV practices.

Inappropriate drug prescription patterns can have negative consequences for patients, including adverse drug reactions, drug interactions, and increased healthcare costs. Therefore, it is important to promote appropriate drug prescription patterns and reduce inappropriate prescribing practices in healthcare facilities in Nigeria (Prach et al., 2015).

This is a controversial issue in Nigeria, as PPMVs are not legally authorised to dispense certain medications, but are often the primary source of healthcare for many people in rural areas. The quality and appropriateness of drug dispensed by PPMVs is a significant concern, as inappropriate drug use can lead to negative clinical and economic consequences (Kodaolu et al., 2020). Nigeria has one of the highest rates of irrational use of drugs in the world, often due to factors such as self-medication, over-the-counter access to antibiotics, and dispensing practices. Assessing the roles of PPMVs in this context is crucial.

Inappropriate drug use can lead to prolonged illnesses, increased healthcare costs, and adverse health outcomes. Improving dispensing practices can lead to cost savings for individuals and the healthcare system. Economic factors, patient expectations and demand among other factors may impact their dispensing habits. Understanding the economic motivations behind their dispensing pattern is crucial for designing effective interventions (Ogunleye et al., 2018). Hence, this study assessed the factors influencing drug dispensing pattern of PPMVs and the effect of patient expectation on their drug dispensing pattern.

Methodology

The study was conducted using a cross sectional design. Data were collected using both quantitative and qualitative (mixed) methods.

STUDY AREA:

The study area was Kwara State, which is the ninth-largest state by size among the 36 states in Nigeria. Geographically, Kwara State is divided into the Guinean forest-savanna mosaic ecoregion, occupying the majority of the state's interior, and the West Sudanian savanna in the west. Rivers are among the state's most notable geographical characteristics. The Awun, Asa, Aluko, and Oyun rivers run through the interior, while the Niger river flows along the state's northern border into Lake Jeba before continuing as a boundary (Kwara State Government, 2012).

Kwara State, which is situated in North Central Nigeria, has Ilorin as its capital. With 3,551,000 people living there as of the 2022 census, it was Nigeria's seventh-largest city in terms of population. The contemporary city is an industrial, economic, and educational hub surrounded by the ancient core area, which is made up of several mosques and typical red-mud single-story homes with thatched straw roofs that are all surrounded by a mud wall. (Kwara State Government, 2012).

To accommodate the demands of its citizens, Ilorin has a public transportation system that includes buses and taxis. In addition, the city has an airport that links it to other regions of Nigeria and the global community. The state's health policies and initiatives are developed and carried out by the Kwara State Ministry of Health. By offering high-quality healthcare services, encouraging healthy lifestyles, and avoiding illness, the ministry seeks to improve the health of the people of Kwara State (Fulani, 2011).

The city is home to foreigners and Nigerians, as well as members of the Yoruba, Fulani, Nupe, Bariba, Kanuri, Igbo, and Hausa ethnic groups. There are sizable communities of Muslims and Christians in the city, and several annual ceremonial events—the majority of which have religious overtones—take place there.

The respondents of this survey were Patent & Proprietary Medicines Vendors (PPMVs) who play a crucial role in delivering essential drugs to the communities in the Ilorin Metropolis.

This study included 400 respondents (trained PPMVs) although 389 questionnaires were retrieved across 2 selected LGAs in the state. For the

qualitative aspect of the study, the respondents were purposively selected from the study population.

A Multistage sampling technique was used.

Stage 1: Selection of Local government areas (LGAs): 2 LGAs were selected randomly from the 3 LGAs in Ilorin Metropolis using a simple random sampling technique by balloting.

Stage 2: Selection of PPMV Zones: In the two LGA selected (Ilorin South and Ilorin West), there are 28 zones (14 in each LGA); 8 zones were randomly selected from each LGA.

Stage 3: Selection of PPMV shops: from each of the zones selected, 25 PPMV shops were randomly selected

Stage 4: Selection of respondents: from each of the selected PPMVs shops, 1 PPMV was purposefully selected on whom the questionnaire was administered..

A convenient sampling was used to select three (3) key informants from each of the LGA, including the chairman. The interview was held at their various secretariats, and each session lasted for about 30 minutes. Permission was sought so that the information gotten from them was recorded and questions related to drugs dispensing and sales were asked.

The study main instrument, especially for the quantitative section of the study, was a semi-structured interviewer-administered questionnaire. Information was sought on the Drug Prescription Pattern of Patent and Proprietary Medicines Vendors (PPMVs) in Ilorin metropolis

For the qualitative component of the study, the instrument was the key informant interviews guide. Certain key points of interest were itemized in the form of questions to aid and guide the discussion. A record (audiotape) of the discussion was taken to ensure that no piece of information was missed.

Four research assistants were recruited for the study. The recruited assistants were trained on data collection methods, using both the quantitative and the qualitative methods.

The validated questionnaire was interviewer-administered. The trained four research assistants also guided the key informant interview for the PPMVs, ensuring that a record (audiotape) of the discussion was well documented.

Questionnaires were checked for errors and omissions at the end of the data collection period to ensure the correctness and completeness of the data. The data collected were checked daily for correctness and completeness. It was coded and analysed using the Statistical Product and Service Solutions (SSPS version 28.0) based on a predetermined analysis plan and the results were presented using tables and charts. Chi-square was used for test of association at $p<0.05$.

Qualitative data generated from KIIs with some PPMV owners were also analysed using transcript-based analysis.A copy of the proposal was submitted to the Ethical Review Committee of the University of Ilorin, Ilorin, Nigeria. The study was approved by the Committee with an approval number **UERC/ASN/2024/2777.** Informed consent was obtained from each participant after explaining the purpose of the study to them. Participants were interviewed after consent was granted for the study. To ensure confidentiality, no name was recorded on the questionnaire. However, codes by which selected PPMVs shops could be traced were generated for re-visiting. Study instruments were kept in a safe place and were only accessible to members of the research team.

Results

There were more females' respondents 289(74.3%) than male 100(25.7%). Most 204(52.4%) of the respondents had secondary and 177(45.5%) had tertiary education. While 2(.5%) had no formal Education, 6(1.5%) had primary. The age of the respondents indicated that 34(8.7%) were less than 25 years old, 238(61.2%) were between 25-40 years old, 108(27.8%) were between 41-55 years old, and 9(2.3%) were above 55 years old. The mean for age distributions was of 36.59 with 8.69 standard deviation.

Table 1: Factors Influencing Antibiotics Dispensing

Items	**Responses**	
	Frequency (N=389)	**Percentage (%)**
Patient demand	330	84.8
Diagnostic uncertainty	13	1.2

Economic incentives	44	4.1
Lack of access to diagnostic tools	291	27.3
Peer pressure	23	2.2
Insufficient training on antibiotic use	308	28.9
Lack of awareness about antibiotic resistance	34	3.2
Pharmaceutical marketing	7	0.7
Regulatory pressure	16	1.5

Multiple response

Table 1 above shows the factors influencing antibiotic dispensing. It shows the results of a survey on why respondents dispensed antibiotics. Respondents were allowed to choose multiple reasons. The most common reason reported by respondents was patient demand, with 84.8% of respondents saying this influenced their decision to dispense antibiotics. This means that more than a third of the time, respondents felt pressured by patients to dispense antibiotics.

Another common reason was lack of access to diagnostic tools, which was reported by 27% of respondents. This suggests that nearly a third of the time, respondents dispensed antibiotics because they couldn't accurately diagnose the illness.

Insufficient training on antibiotic use was another important factor, affecting 29% of drug sales. This means that almost a third of the time, respondents felt they may not have had enough training to know when antibiotics were truly necessary. Less common reasons for dispensing antibiotics included economic incentives (4%), peer pressure (2%), lack of awareness about antibiotic resistance (3%), pharmaceutical marketing (less than 1%), and regulatory pressure (1%).

Table 2: Influence of Patients' Expectations and Willingness of PPMVs to Participate in Trainings

Variables	Response	Frequency (N=389)	Percentage (%)
Do you think that the role of patient expectations has influence in your drug dispensing pattern?	Does not influence at all	9	2.3
	Slightly Influence	18	4.6
	Moderately Influence	348	89.5
	Strongly Influence	14	3.6
To what extent does patient demand for a drug act as a barrier to appropriate dispensing?	Not a Barrier at all	10	2.6
	Minor Barrier	46	11.8
	Moderate Barrier	331	85.1
	Significant Barrier	2	0.5
Would you be willing to participate in training programs aimed at improving antibiotic dispensing practices?	Yes	373	95.9
	No	16	4.1

Lastly, table 2 displays the respondents' willingness to participate in training programmes aimed at improving antibiotic dispensing practices. It revealed that a very high percentage (95.9%) of respondents expressed willingness to participate in training programmes to improve antibiotic dispensing practices. This highlights a strong desire among respondents to enhance their knowledge and effectiveness. Only a small number (4.1%) were not interested in such training.

Table 3: Common Conditions for Drug Dispensing

	Responses	
	Frequency	
	N=389	Percentage (%)
Typhoid fever (unconfirmed)	73	4.8
Common cold,	311	20.2

Diarrhoea (nonspecific),	37	2.4
Vaginal discharge (non-specific),	16	1.0
Fresh trauma wound,	14	0.9
Abdominal pain (non-specific),	16	1.0
Chest pain (non-specific)	26	1.7
Headache	357	23.2
Body pains/aches	354	23.0
Body itching	311	20.2
Body swellings (non-specific),	21	1.4

Multiple response

Table 3 shows the multiple-choice responses on conditions for drug dispensing. It revealed that the prominent conditions included headache (23.2%), Body pain/aches (23%), common cold, and body itching with 20.2% in both.

Table 4: Frequency of Specific Drug Requests, Availability and Dispensing of Antibiotics

Variables	**Response**	**Frequency (N=389)**	**Percentage (%)**
How often do customers request specific drugs or treatments?	Rarely	109	28.0
	Moderately	263	67.6
	Frequently	17	4.4
How often do you dispense antibiotics without a medical prescription?	Rarely	293	75.3
	Moderately	91	23.4
	Readily		
Antibiotics Availability	Available	54	13.9
	Not Readily Available	335	86.1

Table 4 shows the frequency of specific drug requests and dispensing of antibiotics. It indicated that more than two-thirds of the respondents, 263(67.6%) had a moderately frequent request for specific drugs, and 109(28%) rarely had such request. It also showed that about three-quarters, 293(75.3%) of the respondents rarely dispensed antibiotics.

Also on antibiotics availability, it indicated that the majority of the respondents 86.1% did not have it available, while only 13.9% had antibiotics readily available to them.

Key Informant Interview Report

Primary Products Typically Offered By the Patent and Proprietary Medicines Vendor

The PPMVs mainly procured and prescribed Over-the-Counter (OTC) drugs and common (old generation) antibiotics common to the people in every community. It was stated that 23 classes of drugs were approved for sale by the PPMVs. This was established in the statement made by 2 of the chairmen of the association

"The government has approved 23 classifications of drugs for us to sell (Key Informant A). The majority of the PPMV stated that "we mainly sell the OTC drugs i.e. those drugs that have gotten their prescription by the carton or the label (Key Informant A, B, D, E & F). Another key informant stated "we sell antacids, analgesics, aontraceptive pills and protection, antiemetics, anthelmintics, anti-malaria, etc." (KII A),

Influence of Patient's Demand For Antibiotics on Choice of Drug Sales

The PPMVs activities and sales of drugs, especially antibiotics, are often influenced by patients' demand for antibiotics. This is because some patients are familiar with certain antibiotics for some health conditions, so they decline any other drug being prescribed for the complaint they make. This was established in the observation made by Informant B as follows:

"Yes, a patient's demand for antibiotics influences our choice of sales" (Key Informant B). The majority (90%) of the PPMVs stated that "Although antibiotics are not on our drug list, we sell the common ones as a form of assistance to the people in cases where they have come to request for a particular one they have been used to. For example, tetracycline – which the

community refers to as a red and yellow capsule. They come to buy it whenever they have diarrhea. So, sometimes, , no matter the persuasion, they will decline any other product you may want to dispense".

"Yes, some customers come to request antibiotics and they will not be willing to get any other drug" (Key Informant B). Some PPMVs stated that "some antibiotics are very common e.g Ampiclox. When customers come to ask for it and you don't have it, they get disappointed and feel you are not competent. So to avoid that, we stock the common antibiotics" (Key Informant A)

Factors Influencing Drug dispensing

The PPMVs elucidated some of the factors that at one point or another influence their dispensing pattern. It emphasises the role of patient demand in their dispensing pattern. Other factors that influenced their dispensing pattern included poor training of some PPMVs, government policies, drugs on stock, socio-economic characteristics of the patient, and manufacturer's factors. According to a majority of the informants:

"Part of the factors that influence our drug dispensing practice include patient's demand (Key Informant A,C& D), lack of thorough training for some PPMVs (Key Informant A,B & E), patient poor knowledge about drugs (Key Informant B,D,F), government policies and drugs on stock" (Key Informant D,E &F).

Discussion

This study included 389 PPMVs from across two Local Government Areas in Ilorin Metropolis (Ilorin South and West). The study showed that the distribution of the PPMVs by sex had more female as compared to male. This study agreed with Abara et al.(2023) who stated that about two-thirds of PPMVs were in Abuja, FCT; and were women. About 61.2 % of the PPMVs fell within the age bracket of 25-40 years and this also aligned with Agha et al. (2022) and Abara et al.(), who equally stated that more than half of PPMVs were under 40 and about four-fifth belonged to the age group 29 years in Lagos and Abuja.

Also, this study established that 52.4% of the PPMVs had secondary education and 45.5 % had tertiary education. However, this is slightly lower and higher than Agha et al. (2022) who stated that most PPMVs (70%) in Lagos had secondary education and about one- fifth of PPMVs had greater

than secondary education. The result also supported Naomi et al. (2015), who stated that many PPMVs have elementary education levels that are greater than average. In Jigawa, the proportion of PPMVs with a university degree was 57%, whereas in Anambra state, it was 14%. Also, only 23.7% of the respondents had less than 5 years of experience. This is however in line with Abara et al. (2023) that stated that a majority of the PPMVs in Abuja had about 5 years of practice experience.

Beyeler et al. (2015) also stated that between 60-70% of PPMVs stock medications they are legally prohibited from selling, such as antibiotics, and provide diagnostic and treatment services that fall outside their legal scope of practice, such as administering injections. This indicates that PPMVs are responsive to customer demand rather than following guidelines, likely due to their lack of formal pharmaceutical training.

The factor that the majority of the PPMVs claimed to influence their antibiotics dispensing and sales was patient demand. This is, however, in line with Adamu Gadanya, Uthman, et al., (2020), who noted that PPMVs stock and sell medications with positive polarity because of the high demand for antibiotics from people in communities and the profit from sales. This highlights the fact that PPMVs is driven to stock and sell antibiotics due to both community demand for the drugs and sales revenue.

Iheoma et al. (2016) also stated that PPMVs may be motivated by financial incentives, such as the potential for higher profits from selling certain drugs, which can lead them to prescribe or dispense medications outside of their legal scope. In addition, weak regulatory enforcement and lack of consistent dispensing among PPMVs contribute to the widespread practice of selling prescription drugs, such as antibiotics, without proper authorisation.

The test of association indicated that there was no statistical significant association between drug dispensing patterns, and education level of PPMVs. It also indicated that there is no statistical significant association between compliance with drug dispensing guidelines and education level of PPMVs. ($\chi^2 = 1.314$, p-value = 0.726).

Conclusion

Therefore, this study showed that patient pressure is a significant factor influencing the drug dispensing pattern of PPMVs, insufficient training and

lack of access to diagnostic tools. Nearly a third of the time, respondents dispensed antibiotics because they couldn't accurately diagnose the illness. Less common reasons for dispensing drugs included economic incentives, peer pressure, lack of awareness about antibiotic resistance, pharmaceutical marketing and regulatory pressure.

Recommendations

It is recommended that there should be community engagement and education campaigns to inform the public about the services of PPMVs ansd their legal boundary. The use of local media and community leaders to disseminate information and enlightenment about the role of PPMVs in society is highy recommended. Regular training of PPMVs with support of simple diagnostic tool to facilitate appropriate dispending must also be priotised.

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CHAPTER TEN

Globalising Education for Sustainable Development: Bridging Global Approaches and Local Realities

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Abstract

The world is committed to achieving sustainable development, and education is central to the transformative change we wish to see. But the road to globalising education has not been smooth, especially in developing countries, like Nigeria, where local realities often conflict with global frameworks and imported models of education. This study critically analysed the apparent disconnect between global education for sustainable development (ESD) strategies and practical implementation in Nigeria. This study examined the theoretical underpinnings of global integration, drawing on policy analysis, comparative education, and historical reforms. It also discussed challenges such as inadequate infrastructure, curriculum misalignment, digital inequality, and cultural resistance that impede effective global integration. Finally, it suggested case-specific strategies to contextualise planetary educational aspirations without diluting its principled content. Bridging this gap would require a hybrid model that infuses global competencies into local knowledge systems, such as support for experiential learning and education, ensuring that education systems in Nigeria are globally relevant and socially and culturally sustainable.

Keywords: Glocalising, Education, Sustainable Development, Local Realities.

Introduction

The relationship between education and development has been established such that education is now internationally accepted as a key development index, and it is in recognition of this importance that governments all over the world have made commitments in their countries' educational policies for their citizens to have access to education (Odukoya, 2009). Castle in Adeyinka (2012) defined development as "a situation wherein man himself

becomes both the object and the subject of his own improvement, not merely an instrument in a process imposed from above and from without." Education policy issues continue to be a critical concern in developing countries in Africa and a critical tool for development (Imam, 2012). When it comes to education and development, Nigeria's philosophy since independence has been anything but static. At independence, Nigeria's foremost educational objective was to train its nationals to take over its civil service. Educational policy at independence was most concerned with using schools to develop manpower for economic development and Africanization of the civil service (Woolman, 2001). Many changes have been made to education policy over the years in compliance with the changing educational policies across the World. Education for Sustainable Development (ESD) originated in the late 20th century from increasing recognition that the education system must tackle environmental, social and economic issues. Its origins are in the 1972 Stockholm Conference and were more fleshed out in the 1987 Brundtland Report, which popularized the term "sustainable development." These ideas came together at the 1992 Earth Summit and acknowledged education as being central to sustainable development. Global goals, such as the UN Decade of ESD (2005–2014) and SDG 4.7, serve as mandates to incorporate sustainability, global citizenship, and cultural awareness into education.

The world has shown minimal progress on the 17 Sustainable Development Goals (SDGs) despite this progress, signalling the need for stronger locally rooted actions. The need to envision and realise more sustainable futures for people and the planet has become increasingly urgent in recent years, as evident in the limited progress the world has made in achieving the 17 sustainable development goals (SDGs) adopted by United Nations member states in 2015 and which are intended as an holistic framework for realising sustainable futures by 2030 (UN, 2015). The evolution of the Nigerian education system has long been shaped by colonialism and post-independence, with early emphasis on administrative training rather than technical or environmental education (Tijani et al., 2009). Strategies, like the 1977 National Policy on Education, attempted to be aligned with development goals, but were largely driven by donour priorities, lacked continuity, and were poorly funded. Disparities persist between global sustainability concepts and local contextual realities, such as antiquated curricula, underfunding, and socio-political instability.

Nigeria accounts for 15% of the global figure, which is about 10.5 million children aged 5-14 years old. It is the first time the World Bank has fixed this 10% figure, and it says Nigeria is the world capital of out-of-school children. (UNESCO). The country still under-invest in education, with just 7.9% for education in 2024, well below the national recommendation of UNESCO itself of 15- 20%.

This gap between policy intent and implementation underscores the need for historically informed reforms. This article examined global ESD discourse and situates it within the context of Nigeria's educational progress, delineating barriers and opportunities for a more inclusive and sustainability-oriented education practice in the country.

Statement of the Problem

Although there have been improvements towards global Environmental Sustainable Development (ESD), it may be noted that Nigeria has failed in the implementation of ESD issues as global goals. Nigeria's goals had long been at divergence with the international goals since the 2005 World Summit on Social Development held in Geneva, which had agreed in principle to take action for sustainable development at the international level. Nigeria's education system in the post-independence era was centred on the need for trained manpower as opposed to sustainability, and in most cases, colonial models inherited overtly disregarded knowledge of the indigenous people. Inadequate teacher training and professional development represent significant challenges within the Nigerian education system, impeding the quality of teaching and limiting the overall effectiveness of the education system (Obiakor & Okoli, 2019). Continued under-funding, policy instability and political interference also constrain the incorporation of ESD into curricula and teacher training. Addressing these gaps would require a confrontation with the historical foundations of the problem and modifying global models to Nigeria's socio-cultural realities.

Historical context is vital to think through reforms that might work. This study illustrated enabling evidence of how Nigeria's education policies have been shaped by a complex interplay of colonial legacies, global influences, and internal dynamics. It promoted a "glocal" perspective that combines global ESD ideals with local contexts, recognising the importance of

indigenous knowledge and significance of culture. It provided learning that can really help steer other post-colonial nations with a similar strategy to align global mandates to local needs.

Aim and Objectives

This study revisited the historical dynamics between global ESD ideals and education policy in Nigeria. Its objectives were to:

1. explore the historical trajectory of global ESD frameworks;
2. chart Nigeria's engagement with these frameworks;
3. hypothesise historically attuned strategies for bridging global and local education gaps; and
4. Propose pathways that internalise indigenous knowledge, dismantle systemic barriers and localise ESD

Literature Review: Conceptual and Theoretical Framework

The study applied the historical and critical theories to understand the globalisation of ESD and its local pathology in Nigeria.

Key Concepts

Education: A wide-ranging, lifelong process of gaining knowledge and values, formal and informal. Gandhi, Durkheim and others defined it as essentially holistic, socialising. Aristotle: "Education is the creation of sound mind in a sound body."Herbert Spencer: "Education is complete living."

Globalisation of Education: Overseas, the identity of education systems and ideals that span ideals and policy on the international stages.

ESD: Provides learners with the skills and values needed to tackle global issues such as climate change and inequity. UNESCO views ESD as a key to unlocking progress towards the global development goals, equipping people of all ages with the tools to address challenges like climate change, biodiversity loss, and inequality.

Localisation In Education: Adapting and contextualising education models to fit local frameworks, cultures, needs, and knowledge systems. The goal is to create an educational framework that is tailored to the unique needs of a

specific region or community, ensuring that learning materials are relevant and meaningful for students.

Theoretical Approaches:

A. Historical Institutionalism

✓ Looks at how historical decisions and institutional trajectories shape present-day education policies and make it difficult for them to adjust accordingly to new global trends.

B. Postcolonial Theory

✓ Critiques the long-lasting impact of colonialism, arguing that Western knowledge systems have been imposed over indigenous ones and urges for decolonisation in education.

C. The Globalisation vs. Localisation Discourse in Historical Context:

✓ The tension between global models and local needs is an old one from colonial education to contemporary development goals. Grasping this tension is important for situating ESD in Nigeria as it stands today.

A Historical Perspective on Global ESD Agendas

Key milestones and changing global discourses have driven ESD forward. This history matters because it reveals the extent of the disconnect between global frameworks, such as the Paris Agreement, and local implementation, particularly in countries like Nigeria.

Timeline of Key Milestones:

- Stockholm Conference (1972): The United Nations Conference on the Human Environment recognised the environmental crisis and proposed Environmental education, which laid the foundation for the introduction of sustainability in education.
- Brundtland Report (1987): Provided a definition of sustainable development and emphasised education as a key to realise a balance between growth, preservation and equity.
- Earth Summit, Rio de Janeiro (1992): The United Nations Conference on Environment and Development (UNCED) adopted Agenda 21, where education was established as one of the critical vehicle for

sustainability as is particularly addressed in Chapter 36 on public awareness and training.

- UN Decade of Education for Sustainable Development (2005–2014): An initiative launched by UNESCO to build sustainable thinking, acting and living in education but with region based influences.
- Sustainable Development Goal 4.7 (adopted in 2015): Of many international commitments made by countries, SDG 4.7 was to ensure that all learners acquire knowledge and skills needed to promote sustainable development, including sustainable development of global citizenship and gender equality by 2030. (UNESCO)
- Shifting Global Narratives about education and sustainability: The world narrative has changed from the need to educate for the environment to the realisation that education itself is essential to address issues facing the world. With the 21st century skills approaches, there is now an emphasis on critical thinking skills, participatory learning and cultural relevance in the classrooms.

Nigeria's Education Development and Response to ESD

With over 350 different ethnic groups speaking more than 500 languages, Nigeria's diverse population has specific challenges when it comes to localising ESD. In this section, we discuss Nigeria's colonial and post-colonial educational legacies, engagement with international sustainability frameworks and ESD implementation barriers.

Colonial and Post-Colonial Education Policies

- The introduction of formal education in Nigeria was mainly through Christian missionaries who incorporated Western values at the expense of indigenous knowledge. The colonial education system emphasised developing clerks not individuals.
- *National Policy on Education (1977 and Revised):* The post-independence policies were self-reliant, but adopted, at least, to the extent of being a replicate of foreign policies and did not leave sufficient room for sustainable growth or global citizenship.
- MDGs/SDGs: The t two frameworks have measurable targets of 2000, Nigeria is still taming to universal basic education and gender equity.

Nigeria's pledge to Education-for-Sustainable-Development (ESD) had not been shattered after SDG 4.7 was adopted in 2015, but its implementation was selective and inconsistent.

- ESD-related curricula: Initiatives to mainstream sustainability themes into curricula are disparate and underfunded, and there is a yawning gap between curriculum development and the realities of classroom practice. This article examined these structural and ideological discrepancies that have troubled ESD integration in Nigeria.

Sustainable Localisation of Global ESD: Strategies

Algorithms to Measure the Impact of Historically Informed Curricular Reforms

Curricula reforms must go beyond simply introducing global concepts into textbooks. Traditions, demonstrating how previous implementation of improvement illustrates reform that involves teachers, reflects their values, and suits a given cultural context (sometimes what worked better were informal or relaxed surroundings which promote learning more effectively than the normal classroom analogically speaking environment). A contextualised ESD curriculum needs to integrate global competencies (e.g. climate literacy, global citizenship) with local knowledge systems, culture, languages and practices. UNESCO says that a language which is perfectly suitable for literacy must be known to both the learners and the teachers, and it should also be used as a communication medium (UNESCO 1992:23).

Simply put, this is the institutional memory and kneading of policies.

There are also lessons to learn from successful programmes that have come before. For example, the Agricultural Science uses of the 1980s or community based adult literacy programmes which have proven frameworks that can be invaluable in the broadening of ESD. In the 1980s, Nigeria was flooded with agricultural research programmes like Structural Adjustment Programme (SAP) aimed at transforming agriculture for commercial production and food self-sufficiency, and buildings up to research institutes and Directorate for Food, Roads and Rural Infrastructure (DFRRI). Also, during this period, the National Accelerated Food Production Project (NAFPP) was founded in 1973; Nigerian Agricultural and Cooperative Bank (NACB) was also founded in 1973 and the Integrated Agricultural

Development Projects (ADPs) and the National Grains Reserve Programme(NGRP) were introduced in 1975. The NAFPP was created as the acceleration of major staple crops production. There were also National Programmes for Grains and Root Crops Cultivation, again, to increase the production of its mandated crops. ((Akinboyo, O. 2008)

Such a dedicated initiative could help monitor and hold accountable the advances made on ESD, and maintain continuity of knowledge and efforts associated to ESD, despite the general shifts of political cycles.

Community Engagement

Community engagement involves the active participation of community members, parents/ guardians, and local organisations and stakeholders in the educational process. It is a multidisciplinary model that considers the unique and strength of the entire community working together to aid in the improvement of education. (Jegede & Ogunleye, 2021). The historical neglect of local voices at Table of Education Policy has resulted in a top-down approach which most of the time is far from ground reality. This trend needs to be reversed for sustainable localisation of ESD. More relevant and effective educational practices can also emerge from these shared decisions that are made with insight, cultural perspectives and local expertise. (Amos,, 2024). Many ESD policies should be co-developed with teachers, parents, students, and community leaders, drawing from participatory traditions of town-hall meetings and local governance systems. Such inclusion garners ownership and aligns reforms with socio-cultural mores and could enhance student learning achievements through a supportive and nurturing environment. Then, by stepping into roles as mentors or helping plan educational events, community members put additional resources and experiences as well as role models at students' disposal. Moreover, community engagement enhances the school-family bond. This might result in an active parental involvement, improved communication and a better support for student learning at home (Obiakor & Okoli, 2019).

Historical Lessons and Strategic Directions

Lessons learnt from previous reforms in education should be used in localising ESD in Nigeria. Nigeria's post-independence educational reforms have fluctuated between aspirations for global relevance and the imperatives of national identity. Historical evidence indicates pathways for aligning global

ESD objectives with local contexts through localised curricula and inclusive policy development. In the quest for rapid development and in pursuance of meaningful educational development, the Western Regional Government gave education highest priority.

Nigerian Educational Policy from Colonial Rule to Post Independence (1914-1960 and Now)

The 1925 memorandum regarding educational policy for British Tropical Africa initiated by the British colonial government resulted in the 1926 Education Ordinance. This ordinance came on the heels of the Phelps-Stroke Commission's recommendations to improve education efficiency and shut down unregulated schools. It called for increased investment in education, formal education suited to local conditions, stresses on vernacular studies, women's education, moral training, etc. It was the first policy to incorporate local content and it steered education in Nigeria from 1926 to 1945.

The 1948 Education Ordinance

The 1948 Ordinance, enacted through Sir Arthur Richard subsequent to several reports and the 1946 educational plan administered education centrally, supported regional education boards, privatisation, and enhanced incentives. It also framed grants assessment for mission schools, decentralised educational governance.

The 1952 Education Ordinance

As the quest for self-governance became louder in Nigeria, the McPherson Constitution of 1951, which consolidated Nigeria into three regions, emerged. Thus, the Education Ordinance of 1952 granted the various regions the power to develop their own educational plans and policies, and ultimately led to the dissolution of the Colonial Education Board.

The Regional Education Laws (1955 – 1957)

The 1954 Federal Constitution granted each region the authority to draft its educational laws, resulting in the enactment of regional education laws such as the Western (1955) and Eastern (1956) templates, as well as the Northern (1957) region and the Lagos Education Ordinance (1957).

The Ashby Report (1959)

The Ashby Commission was constituted to examine Nigeria's manpower needs between 1960-1980 stated. It came with the resolution that more primary and secondary schools are required to promote socio-economic growth of the nation and socio-economic development of the individual and that the decentralisation of authority would be maintained as the dominant pattern of education administration until Independence in 1960.

National Educational Policy of Independence (1960–1979)

After independence, Nigeria created 19 states by 1976, each with its own education laws. The National Policy on Education (NPE) -1977, was the first indigenous policy and its main objective was to bring about unity and national integration through education.

The Education Laws of the School Republic (1979–1999)

Based on military hegemony, the second republic (1979) of Nigeria was inaugurated under another constitution which placed education within the ambit of the concurrent legislative list. In 1976, a UPE (Universal Primary Education) policy was instituted with a target of increasing enrolment but this was short-lived ending in 1981 when monetary challenges forced the government to cut expenditure; thus facing striking teachers and declining standards. UBE was introduced in 1999, replacing UPE to provide equal educational opportunities.

So far, Nigeria’s educational policy has been progressively adapted to the colonial policies instead of building new, local frameworks.

Conclusion/Recommendation

The study mapped the evolution of global ESD, from the Stockholm Conference (1972) to SDG 4.7 (2015), capturing evidence of increasing integration of sustainability perspectives into education throughout the globe. Yet, Nigeria’s case, like many other countries, demonstrates a wide disparity between such global aspirations and national/local action, mainly owing to the colonial legacies of education, socio-political instability, poor funding and infrastructural hindrances.

Historical evidence suggests that Nigeria's attempts to adopt international norms have rarely been genuine, and where they have, they have fallen well short of the realities of cultural and socio-economic conditions in Nigeria. The

study highlighted that attempts to import models from around the world without accounting for local contexts regarding historical legacies, indigenous knowledge, and local values are largely ineffective in moving reforms forward.

This makes bridging global sustainability aspirations with Nigeria's history and culture very important. This necessitates participatory and historically cognizant reform with boots on the ground engaging local communities, educators, and policymakers. By analysing the historical and global context what has worked and what has not, Nigeria has the capacity to not only produce a globally competitive education system, but one which is also grounded in local culture, essence, needs, and relevance, thereby creating a more effective, appropriate, eco-friendly future of education.

Recommendations

1. Revive Technical and Vocational Training

Technical and vocational education schools should be upgraded and included in the basic education system so that students receive job-ready skills, while promoting self-reliance and entrepreneurship and reducing youth unemployment.

2. Re-establishment of Teachers' Training Colleges

Reintroducing Teachers' Training Colleges will strengthen foundational education, especially in under-served communities. These institutions produced competent, community-rooted educators who understood local realities. Their return would promote inclusive and contextually relevant teaching, a core element of ESD.

3. Reflect Indigenous Arts and Crafts in the Curricula

Integrate indigenous knowledge systems (such as pottery, weaving, wood carving, etc.) within school curricula to promote cultural sustainability, creativity, and respect for local traditions.

4. Agricultural education should be strengthened

Focus on practical farming programs to improve agricultural education using the existing school farms to reconnect students with sustainable food practices, traditional farming techniques, and environmental stewardship.

5. Localise School Curricula

Develop a curriculum which integrates Nigeria's social, cultural, economic, and ecological context into it and which makes global goals including ESD relevant and sustainable for local communities.

6. Promote Inclusive Education

Nigeria should adopt flexible and inclusive education policy. Expand initiative by encouraging open and Distance Learning, vocational schools, and community learning centers.

Revising Academic Policies for a More Inclusive and Sustainable Education

7. Professional Experience for Postgraduate Admission

Take on an inclusive admission structure, acceptance of professional experience as a portion of postgraduate entrance, validated informal learning, empowering each authority so you can achieve a non-linear-wound scholastic course.

8. Ease O'Level Requirements for Postgraduate Degrees

Scrap outdated policies and rules like insist on O'Levels for postgraduate study, thereby, promoting more inclusive and flexible pathways for adult learners.

9. Develop Alternative Ways for Non-Traditional Students to Gain Admission

Increase access for adults and non-traditional students through relaxed pathways (competency-based assessments, portfolio-based admissions) that expand educational opportunities for those who may not fit the traditional model and will support both the working learner and the goals of employers to prepare current and future employees for the future of work.

10. Open and Distance Learning Platforms

Promote open and distance learning (ODL) to develop education access for marginalized groups and working adults, who could benefit from ODL as it

provides inclusive education and allows marginalised groups to overcome structural barriers.

11. Embed Experiential Learning into the Curriculum

Scale open academic models that embed real-life experience, community engagement and local knowledge in the formal curriculum, aligning top-down education requirements with local realities.

12. Adopt a national admission policy review and reform process for SDG alignment

National education policy and practices should align with SDG 4, including components such as equitable access to affordable technical, vocational and tertiary education, and considerations for integrating education for sustainable development, among others.

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CHAPTER ELEVEN

Effectiveness of Team Building Activities in Enhancing Trust and Transparency within Virtual Teams

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Abstract

This quantitative study investigated the effectiveness of team-building activities in enhancing trust and transparency within virtual teams, a crucial area given the increasing prevalence of remote work. It addressed the challenges of fostering cohesion in geographically dispersed teams reliant on digital communication. Using surveys and assessments, the research measured the impact of interventions such as virtual workshops and collaborative tasks on key metrics: psychological safety, communication clarity, and accountability. The study sought to measure cognitive and affective trust among virtual team members, evaluate the impact of specific team-building activities on perceived transparency, and identify the most effective activities for enhancing trust. It also examined the correlation between the frequency of these activities and the levels of trust and transparency, while considering the influence of demographic factors. The outcomes of this research would inform strategies to optimise team dynamics, improve decision-making, and mitigate conflicts within virtual teams. The evidence-based findings aimed to guide organisations in developing comprehensive frameworks for virtual team collaboration and performance optimisation. This study would contribute to both academic discourse and practical application in organisational settings, offering insights into strategies that could enhance team performance, collaboration, and productivity in remote work environments.

Keywords: Virtual Teams, Team-Building Activities, Trust, Transparency

Introduction

The rise of globalisation and advancements in technology have revolutionised organisational operations, leading to the widespread adoption of virtual teams. These teams, characterised by geographic dispersion and reliance on digital

communication platforms, offer numerous benefits such as flexibility, cost savings, and access to a diverse talent pool (McEwan *et al*., 2017; Hoch & Kozlowski, 2014). However, the absence of physical interactions introduces challenges in fostering trust and transparency - two critical components for effective teamwork.

Trust in virtual teams is categorised into cognitive trust, derived from perceptions of competence and reliability, and affective trust, which evolves from emotional bonds and interpersonal rapport (Kanawattanachai & Yoo, 2002). Transparency, on the other hand, ensures that all team members have access to relevant information, enabling informed decision-making and accountability (Palanski *et al*., 2011). In virtual environments, asynchronous communication, lack of non-verbal cues, and potential information silos often hinder these elements (Erez *et al*., 2023).

Team-building activities have traditionally been used to strengthen relationships and improve collaboration in co-located teams (Tannenbaum *et al*., 2012). In virtual settings, these activities must be adapted to address unique challenges such as isolation, communication barriers, and cultural differences (Sivunen & Hakonen, 2011). Despite their potential benefits, there is limited research on the effectiveness of team-building activities in enhancing trust and transparency within virtual teams. This study aimed at filling this gap by investigating how team-building activities impact these critical dimensions.

Literature Review

Virtual teams represent a paradigm shift in organisational collaboration. Unlike traditional co-located groups, virtual teams rely heavily on digital platforms for communication and collaboration. While this model offers flexibility and scalability, it also introduces complexities in fostering interpersonal cohesion (Ferreira & Rodrigues, 2023; Morrison-Smith & Ruiz, 2020). In these settings, trust is a critical construct that underpins successful collaboration. It manifests in two distinct dimensions: cognitive trust, which is derived from perceptions of competency and reliability, and affective trust, which evolves from emotional bonds and interpersonal rapport (Breuer *et al*., 2016; Ford *et al*., 2017).

Transparency in virtual environments further contributes to team effectiveness by ensuring that information is openly shared and accessible, thereby

facilitating informed decision-making and accountability (Howard *et al*., 2020). The absence of face-to-face interactions often impedes natural communication channels, making deliberate strategies for maintaining clarity and openness imperative (Marlow *et al*., 2017). Against this backdrop, team building activities emerge as instrumental interventions designed to mitigate the challenges posed by digital collaboration. These activities, ranging from interactive virtual workshops to collaborative problem-solving simulations, seek to create opportunities for shared experiences and authentic connections, ultimately reinforcing both trust and transparency within virtual teams (Hertel *et al*., 2005; Sivunen & Hakonen, 2011). Collectively, these elements underscore the transformative potential of targeted team building approaches in harnessing the full collaborative capacity of distributed workforces.

The increasing prevalence of virtual teams as a dominant mode of collaboration in today's globalised and technologically advanced organisational landscape necessitates a deeper understanding of the mechanisms that foster effective team dynamics. Trust and transparency are critical components of this dynamic; they are essential for overcoming the inherent challenges of reduced physical presence and the limitations of digital communication platforms (Altschuller & Benbunan-Fich, 2010; Hertel *et al*., 2005).

Trust in Virtual Teams

Trust is foundational for effective teamwork. In contemporary organisational settings, particularly within virtual teams, trust facilitates the development of resilient social bonds despite the absence of face-to-face interactions (Wilson *et al*., 2006). Scholarly literature often conceptualises trust in teams along two interrelated dimensions: **cognitive-based trust** and **affective-based trust.** Cognitive trust is built on perceptions of competence and reliability (Kanawattanachai & Yoo, 2002), while affective trust stems from emotional bonds formed through positive interactions (Breuer *et al*., 2016). In virtual settings, the absence of face-to-face interactions often delays or inhibits the development of both types of trust (Jarvenpaa & Leidner, 1999). Breuer *et al*. (2016) further highlighted that the absence of non-verbal communication in virtual environments slows down the formation of affective trust which relies on emotional connections and personal rapport to take effect. In the absence of facial expressions, body language, and immediate empathetic responses,

team members may develop a cautious approach to collaboration, resulting in a slower and less robust trust-building process. The cumulative effect of these challenges highlights the need for deliberate interventions, such as tailored team building activities, to bridge the interpersonal gap and foster a healthier trust continuum in virtual teams.

Transparency in Virtual Teams

Transparency in a team context is defined as the consistent and availability of relevant information that empowers team members to make informed decisions and fosters accountability within the group (Edmondson, 1999). Studies have shown that transparency transcends mere data sharing. Other important factors like the clarity and accessibility of the process, the rationale behind decisions, the timeliness of project progress updates (Edmondson, 1999; Palanski *et al*., 2011) are equally very key. By ensuring that critical information is accessible, teams can align their efforts more effectively, anticipate challenges, and respond collaboratively to emerging situations (Mesmer-Magnus & DeChurch, 2009).

Environments with these features improve the process of decision-making by reducing uncertainties and preventing information silos, which are some of the common issues with virtual settings. Furthermore, transparency promotes accountability as it enables individuals to understand not only what decisions are made but also how these decisions impact overall team performance (Rawlins, 2008). In virtual environments, maintaining transparency requires deliberate strategies such as regular updates, clear documentation, and collaborative tools that facilitate information sharing (Leonardi & Contractor, 2018). Without these practices, misunderstandings can arise, negatively impacting team cohesion (Marlow *et al*., 2017).

Role of Team Building Activities

Team building activities are structured interventions aimed at improving interpersonal relationships and team cohesion. Tailored team building activities are designed to directly address the challenges of trust and transparency within virtual teams. By incorporating interactive elements such as virtual workshops, escape rooms, and collaborative group simulations, these structured interventions provide team members with opportunities for reciprocal interactions that mirror the spontaneity and depth of face-to-face engagements (Lansing, Nikolaidis, & Cosier, 2017). Such activities foster

cognitive trust by enabling individuals to assess each other's reliability and competence through structured, observable tasks. Simultaneously, they cultivate affective trust by generating shared experiences and emotional bonds that are typically underdeveloped in purely asynchronous digital interactions (Sivunen & Hakonen, 2011).

Moreover, these activities enhance transparency by establishing standardised protocols for information sharing and real-time feedback, thereby reducing the occurrence of communication silos and ensuring that critical information is accessible to all team members (Gibbs, Maznevski, & Sung, 2017). The integration of structured team building in virtual settings thereby provides a dual benefit: it enriches the communicative quality of digital interactions and creates a stable foundation for trust development that is both rationally and emotionally grounded.

Research Methodology

This study adopted a quantitative research design rooted in a systematic method to empirically examine the effects of team building activities on trust and transparency within virtual teams. A quantitative approach is most appropriate for this investigation because it allows for the measurement of abstract constructs through standardised instruments, the testing of hypotheses, and the establishment of statistically significant relationships among variables (Creswell & Creswell, 2017).

The research is structured as a cross-sectional study using a survey methodology, which captured data from virtual team members at a single point in time. Data was collected using validated questionnaires administered to employees across multiple organisations that employ virtual teams. The survey measured respondents' perceptions of interpersonal trust, the clarity and openness of information exchange (transparency), and the perceived effectiveness of various team building activities.

The research population for this study comprised individuals who actively participated in virtual teams within organisations operating in today's global and digitally connected economy. Virtual teams are defined as groups of employees who collaborate toward shared objectives while being geographically dispersed and relying primarily on digital communication platforms. To capture the nuances of virtual team dynamics, the population included both team members and their leaders, ensuring a comprehensive

understanding of how trust and transparency are cultivated through team building interventions. Participants were drawn from a variety of industries such as technology, consulting, and professional services where the adoption of virtual work settings is prevalent.

Data Presentation and Analysis

In measuring the level of cognitive and affective trust among virtual team members, the results indicated that team-building activities significantly enhance both cognitive and affective trust among virtual team members. Respondents rated their levels of trust and transparency within virtual teams as moderately high, with mean scores of 3.8 (SD = 0.6) for trust and 3.6 (SD = 0.7) for transparency on a 5-point Likert scale. The perceived effectiveness of team-building activities was also rated positively, with a mean score of 4.1 (SD = 0.5). These findings suggest that team members generally perceive team-building interventions as beneficial for fostering collaboration.

Variable	Mean	Standard Deviation (SD)	Correlation Coefficient (r)	p-value
Cognitive Trust	3.7	0.6	0.68 (with Team-Building)	< 0.001
Affective Trust	3.9	0.7		
Transparency	3.6	0.7	0.62 (with Team-Building)	< 0.001
Team-Building Activities	4.1	0.5	-	-

In evaluating the impact of team-building activities (e.g., virtual workshops, collaborative tasks) on perceived transparency of communication, this table highlights the statistically significant differences in perceived transparency between those who participated in virtual workshops and collaborative tasks versus those who did not. The lower p-values indicate a strong likelihood that these activities positively influence transparency. Interactive collaborative activities, such as virtual escape rooms and group simulations, were found to

be more effective than passive activities like webinars as they foster emotional bonds among team members. These results align with previous research suggesting that shared experiences are instrumental in building affective trust (Kanawattanachai & Yoo, 2002).

Team-Building Activity	Mean (Participants)	SD (Participants)	Mean (non-participants)	SD (non-participants)	p-value
Virtual Workshops	4.2	0.5	3.3	0.6	< 0.001
Collaborative Tasks	4.0	0.6	3.5	0.7	< 0.001

Moreover, the study highlighted a positive correlation between the frequency of team-building activities and perceived transparency. The Pearson correlation coefficients (r) and p-values indicate statistically significant positive relationships between the frequency of team-building activities on both trust and transparency. Regular engagement in structured activities ensures consistent communication flow and reinforces mutual understanding among team members. This suggests that more frequent team-building efforts are associated with higher levels of trust and transparency within virtual teams. This supports existing literature emphasising the role of transparency in improving decision-making processes within virtual teams (Palanski *et al*., 2011).

Variable	Pearson's (r)	p-value	Interpretation
Trust	0.68	< 0.001	Strong positive correlation
Transparency	0.62	< 0.001	Moderate to strong positive correlation

Despite these positive outcomes, challenges remain. Passive or individual-focused activities such as webinars were less effective in enhancing trust or transparency compared to interactive formats. This suggests that active participation is crucial for achieving meaningful outcomes.

Conclusion

This study provided evidence that team-building activities are effective tools for enhancing trust and transparency within virtual teams. By fostering cognitive trust through competence-based tasks and affective trust through shared experiences, these activities address key challenges associated with remote collaboration.

The findings emphasised the need for organisations to invest in regular and interactive team building initiatives tailored to their team's demographic composition. Such interventions not only improve interpersonal relationships, but they also create a transparent work culture conducive to collaboration and innovation.

As remote work continues to grow globally, understanding how to optimise virtual team dynamics becomes increasingly important. Future research should explore additional variables such as cultural diversity or technological proficiency to further refine strategies for managing virtual teams effectively.

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CHAPTER TWELVE

Glocalisation of Africa's Untapped Heritage from Primary to Tertiary Education: Community Service of Higher Education

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Abstract

Higher education is the bridge that connects town and gown; they delve into the corners to turn ideas into opportunities. Higher education instruction should, therefore, encourage pupils to experiment. To preserve the slowly deteriorating cultural values and increase the chances of cooperative inquiry-based learning, creative problem-solving, and creative activities, the GLOCALISE strategy, which combines global and local values, should be employed. When youngsters are not exposed to a culture, it dies too soon. As a result, all educational levels should incorporate the idea of glocalisation into their curricula. At the primary level, this should take the form of a role-playing or storytelling approach; at the secondary level, it should be project-based; and at the tertiary level, it should be problem-solving. Each level's various concepts ought to be connected to a proverb, idiom, artefact, antique, custom, or culture. Contextualised learning makes a lot of sense; it is enjoyable for students and fosters critical thinking and teamwork. Therefore, this paper examined how the GLOCALISE strategy is using crowdsourcing to explore some African cultural heritages globally (locally and globally) while creating tools for teaching and student involvement that are available to educators, parents, and other interested stakeholders. GLOCAL professionals update and validate the curriculum, assessment, and instructional materials. It is envisaged that this strategy will foster the creative minds of Africans and turn unexplored African history into invaluable gems for the world.

Keywords: Glocalisation, Unmined Heritage, Community Service, Higher Education

Introduction

When the colonial masters came to Africa, they gave and took. Among what they gave was cultural erosion, while what they took, they claimed its birth right. Adaptation of what they termed barbaric in our culture became the stepping stone of their civilisation in Medicine, Information and Communication Technologies (ICTs), Computing Systems (CS) and more. *Aroko*(hieroglyphics), the African ICT and CS, as derived from *Ifa* Binary Systems in Yoruba culture in Africa, are typical examples. The premise of this paper though is not to cry over spilt milk, but to reposition our cultural heritage in the global stage through Glocalisation. To Glocalise is to dig deep into our rich cultural heritage to develop new or enrich existing areas of science and technology. A culture that is hidden from children goes into extinction too soon.

Globally, some values are universal while locally some are specific to different cultures and traditions. To synchronise these values and bring out the uniqueness in them, the term GLOCAL refers to a blend of global and local values, ideals, resources, games, play, riddles, poems, proverbs, hieroglyphics, stories, songs, arts and antiques for learning concepts in universal and specific contexts. This is an effort to connect the slowly vanishing old African cultural values with the social and educational ideals of today. This calls for increasing involvement by creating a network of educators, subject-matter experts, local and cultural specialists, government organisations, parents, school administrators, and other interested parties to discuss ways to increase learning opportunities for students while promoting the development of community values.

Glocalise approach embraces cultural phenomena and tools to triangulate ideas in the vast and culturally diverse African setting. Key components of the learner-centered contextualised learning paradigm are inquiry-based learning, learner engagement, and learner-context. It encourages students to actively engage in their education and places a strong emphasis on placing learning within their life experiences and immediate surroundings. It requires student participation through practical exercises to guarantee that students acquire knowledge of scientific ideas and transform them into problem-solvers. In order for students and teachers to work together on problem-solving and inquiry-based projects and become creators of novel practices and

methodologies, it is implied that pedagogical techniques and practices are established creatively and flexibly.

In education, glocalisation refers to the use of a learner-centered approach to explore local context to teach global content while producing new and outcome-based glocal (Global and Local) content resources. Examples of this include refining the products of cultural practices and creating local versions of modern technologies, expanding the inventive scientific discoveries from indigenous cultural heritages, and proposing laws based on cultural insights.

It is, therefore, essential to incorporate the idea of glocalisation into the curriculum at all educational levels, enhancing it with imaginative exercises that address pressing issues in our local setting. Our setting becomes global, and our education becomes meaningfully outcome-based when students acquire and use their abilities to improve our immediate surroundings. Teachers and students both become creative innovators rather than merely polite consumers. Our goal at glocalise is to learn about the global scene to create a local scenario and promote on the glocal arena.

Anchored instruction, also known as situated cognition learning, active learning, discovery learning, constructivism, cooperative/collaborative learning, connectivism, experiential learning, design-thinking, and many more theories support GLOCALISE. Adedokun-Shittu, AbdulKabir and Nuhu, (2018) succinctly described that discovery learning is inquiry-based approach that encourages learning by doing, through observation and organised activities that is guided or unguided by a teacher in a way that makes it viable for problem-solving. Constructing new knowledge through learning activities revolving round student experiences, dialogue, doing and observing is promoted by active learning model. Cooperative/collaborative learning develops support skills in students rather than competitive skills. Connectivism is a theoretical construct for learning in the digital era focused on creating connections and networks to facilitate learning among diverse people and communities for cooperative, peer and team collaborative learning. Experiential and design-thinking models adopt problem/project-based learning approach to ensure students experience learning by doing and tinker as they apply theories and concepts in real life problem-solving situations.

Constructive review and practical implementation of these theories in real life situations can produce fruitful learning outcomes in students while also

studying phenomenon, drawing conclusions, confirming or rejecting prior notions and making observations that may subsequently develop into novel concepts and fresh models. Global norms encourage the discovery of new information, while Africa's poorer nations are still confined to repeating what has already been discovered. It is time to stop our next generation from starting from scratch. Instead, let us take a big, brave step toward producing knowledge while politely absorbing that which has already been produced. This can begin when we instill in our kids the values of observation, inquiry, problem-solving, teamwork, and solving issues on their own instead of just consuming old stories that were created by the great minds of the past. We need to start producing the brightest minds of our own and the next generation!

How exploratory will it be to teach encryption, image representation, programming by exploring *Aroko* (African hieroglyphics), permutation and combination through *ayo olopon*, *lanka lanka* (hopscotch) for programming and algorithmic functions, *odu ifa* and *ayo olopon* for teaching binary representation, create unique audio clips with musical instruments such as *ilu* (drum), apala, fuji, dundun, program a virtual human to perform dance moves (*bata, gelede*) through trigonometric functions, counting rhythm beats "*Eni bi eni, eji bi eji, eta nta gba, erin woroko*,.. to teach elementary counting?" Consider using lanka-lanka (hop-scotch) to teach "addition"—in fact, the entire BODMAS—for addition and subtraction, then tente, tinko, and okoto tita to teach multiplication and division. Consider sayings that relate to ideas in biology, chemistry, or physics. '*Laalaa to roke, ile lo nbo*' - a Yoruba proverb explaining perfectly the 'Law of Gravity'. *Yoo bale, yoo bale ni labalaba fii wo igbo* – an incantation line describing the concept of weight. The Archemedes principle of physics, Iromi to n jo lori omi, onilu re wa nisale odo, describes the upthrust that occurs when a body is submerged in a fluid. *Okere to gun ori ope ree le tente, oju to ile oju to oko* – a squirrel that glances from atop a palm tree, it could see far and wide - (Satellite Communication), *eegun atiro wole, eeyan atiro jade; tani komo pe eegun atiro to wole ni eeyan atiro to jade* - a limping masquerade enters, then a limping person exits, isn't it obvious that it's the limping person that is disguised as the masquerade - Quadratic equation.

All these are in our tradition; we need not wait for an Oyinbo man to call it ETHNOCOMPUTING for us before we adopt it. Dr Ron Eglash came up with

the concept of Ethnocomputing or culturally situated learning to get students to learn to solve problems in creative ways through the use of Culturally Situated Design Tools (CSDT). The CSDTs are web-based software applications that allow students to create stimulations of cultural arts (Eglash, et.al., 2006).

Through this glocalise approach, students will be involved in several in-depth projects to demonstrate application of several scientific and computing concepts in real-life situations. These would ultimately allow them to utilise appropriate tools and methods to carry out in-depth research and gain insights into developing algorithms to solve real- life problems while also reviving our lost cultural glory.

The Glocalise Teaching Methodology

> *The old model of learning facts passively and then reciting them out of context is no longer enough to prepare students in today's world. Solving complex problems involves fundamental skills (reading, writing, math) along with other 21st century competencies such as teamwork, time management and the use of digital tools. Realinfluencer, (2019).*

Glocalise has benefitted from the 21st century teaching methodologies, which are summarised below, and which are revolutionalising learning environments world over while also promoting innovative approaches by educators.

Flipped Learning

Flipped learning or classroom is a reverse pedagogical approach where the primary educational materials are studied by students at home, which are then further discussed in class to optimise time spent on a lesson in order to meet the special needs of each individual student, develop cooperative projects or work on specific tasks.

Cooperative Learning

Cooperative Learning ingrains the "Stronger together" concept in students; building team-spirit in them that working in group improves involvement and acquisition of knowledge and successful accomplishment of tasks. Groups of 3 to 6 members is formed and coordinated by the teacher with each member handling specific task(s) in order to achieve the set objective(s).

Gamification

Gamification is gaining more ground in curriculum and classroom environment. It is one of the bases of edutainment in EdTech industries.

Design Thinking

Design Thinking (DT) helps curricula developers, teachers, researchers and industries to collaborate, tinker, research, innovate, create, problem-solve and bring about reform in teaching methodologies in the classroom and development in the society.

Thinking-Based Learning

Thinking-Based Learning (TBL) methodology develops effective thinking skills in students beyond mere rote memorisation and regurgitation of content. It teaches students to contextualise, analyse, relate, argue, convert information into knowledge, knowledge into working skills and skills into innovative implementation.

Problem-Based Learning

Problem-Based Learning (PBL) is an iterative learning process which begins by asking questions and exploring ways to solve the identified problem. It is an inquiry-based learning with which students develop critical thinking, creative skills and problem-solving knack through quests and knowledge sharing.

Project-Based Learning

Project-Based Learning (PBL) is a classroom innovation that uses experiential learning models and design thinking to get students involved in learning activities that are focused on outcomes. Through projects that address real-world issues without compromising curriculum content, it helps students gain knowledge, skills, and competences. In contrast to the conventional theoretical and abstract paradigm, PBL flips the teaching process by beginning with a tangible problem. It helps students retain information while fostering 21st century skills including communication, critical thinking, and teamwork in problem solving. While the teacher offers guidance and support throughout the project, PBL encourages students to plan, organise, carry out, and present the project's outcome.*"PBL today represents the best didactic guarantee for*

an effective contribution to the development of students' key competencies" Realinfluencer, (2019)

Competency-Based Learning

Competency-Based Learning (CBL) is a collection of tactics used to accomplish the three main objectives of all learning approaches: knowledge acquisition, skill development, and the creation of operational standards. With CBL, tool kits such as teaching devices, assessment rubrics, curriculum roadmap, and training guide are collaboratively developed by teachers and students and operationalised in real- life practices, giving students a concrete dimension to their learning.

All these strategies are learner-centred. The efficiency and effectiveness of instructional process takes place while the teacher interacts with the learners through explanation, exploration, experimentation and discussion while students gain competency in the three Cs of the 21st century (communication, critical thinking and collaboration). Learning as an activity takes place while the student's mind is actively engaged through a series of well–structured experiences. Teachers prepare the lesson in an activity-based approach and guide the students to self-discover concepts contextually. Teachers need to consider certain crucial factors while adopting learner-context approach as successfully implemented in a study by Adedokun-Shittu, Abdulkabir, Nuhu (2018). These include teachers: recognising the fact that students are not empty vessels and they emanate from an environment where their lived experiences can complement their learning, if creatively and constructively connected to concepts; collaborating with colleagues and students both physically and virtually. They are expected to come up with relevant ideas to teach different topical issues in varying subjects; exploring language, culture, childhood games, proverbs, as rich resources to learn from and relate subject concepts to and to facilitate contextual understanding. This requires teachers to be grounded in both subject content and local context, engaging students to take active role in their learning rather than passive listener in class. These interactive and student-engaging activities should be provided for in the lesson plan, making ample provisions for relevant problem-based and inquiry-based activities for each topic. These can be achieved more effectively if students' observation from the activities are carried out form their notes or diary.

Flipping the classroom with web resources such as videos, audio, texts, real setting excursion could also be employed to complement contextual teaching.

Having studied and used many methodologies available globally for 21st century learning, GLOCALISE carefully adapted the following methods to our local context. These methods are discussed as applied by GLOCALISE across all levels of Education in Nigeria.

Glocalisation of Education at the Basic, Secondary and Tertiary Levels of Education

Basic education, secondary school education, and university education are the three main levels of education in Nigerian society, Africa, and the rest of the world. Children between the ages of four and fourteen are typically offered basic education, which includes three years of early childhood and development education, six years of primary and junior secondary schooling, three more years of senior secondary schooling, and four or more years of tertiary education (Nwangwu, 2012). The Nigerian educational system is divided into three promotional levels, according to the National Policy of Education: postsecondary education, post-basic and career development (PBECD), and basic education. Pre-primary education, primary education, junior secondary education, and early child care development education (ECCDE) make up basic education.

Technical and vocational education and training (TVET) and senior secondary education make up the PBECD. University education, teacher education, technological education, and innovation enterprise institutions are all considered tertiary education (Federal Republic of Nigeria, FRN, 2014). It is crucial to stress that students are expected to accomplish a variety of goals and objectives at each level, including the development of suitable mental, physical, and social skills and competencies that will enable them to make valuable contributions to society.

What Should Students' Learning Experience Be Like? Discovery in Learning

What excitement is felt by a child and parents as the baby takes his/her first step? The baby is our student, while the parents are the teachers. That's the excitement every student and teacher should experience in every class.

MESSAGE: Discover something new in every topic you explore with your students. Let our students EUREKA!!!. Teachers also become part of the learning experience; they become partners in discovery. He/she searches for appropriate resources for contents to explore, design relevant problem-based classroom activities for students, prepare the activity guide for every flipped learning, design rules and procedure for game-based learning and provide guide for students' diary. All these are entrenched in the roles designated for teachers as: Facilitator, Designer, Collaborator, and Learner (ISTE – International Standards of Teacher Education, 2022). Rather than copying teacher's note, students should develop their diaries from observations made during the exploration or activities. Teachers in turn analyse the content of the resources provided, critique students' diary, compare their observations, note some inconsistencies in their submission and reconcile them.

At the Primary level

Storytelling, replicating moonlight tales is an effective learning strategy for primary school age pupils. Story-telling is a fascinating method of capturing and sustaining students' attention. When relevant stories are told in class it brings out meaningful moral lessons that will allow students to link subject content to local context. Story-telling could also lighten the tension in subjects presumed to be difficult and boring. Interactivity is also ensured with story-telling when students are requested to contribute the moral lessons of the story or relate it to the topic of discourse. The story of how Noah's Ark was constructed could come in as teachers teach floating, students marvel at how a gigantic ark could stay afloat on water and practice how to make a boat, paper boat etc. More fun is added to the class if the story has songs with stanzas to chorus. It becomes much more fascinating if the story is accompanied by a song to be chorused by the pupils e.g. *Asirin toun tokere, joo mi jo, awon ni won jo nja, joo mi jo….*

Game is an activity-based method of capturing students' cognitive involvement in the topic or subject to be taught. Both physical and computer-based games serve the purpose of fun and educative engagement of the students in the topic. Many of the childhood games we played can seamlessly come to play while teaching. Besides improving the cognitive and social skills of students, games can impress a meaningful and permanent experience about the lessons on the students. GLOCALISE games include: "*Eni bi eni, eji bi*

eji, eta nta gba, erin woroko,.. to teach elementary counting" *lanka-lanka* (hop-scotch), *ayo olopon*, binary, for addition/subtraction, *tente, tinko, okoto tita*, to express BODMAS.

At the Secondary Level

Teach Thinking: use computational thinking strategies – procedural or algorithmic skill.

Thinking Activity:

Now, take your pencil and paper:

Calculate this:

Add up all the numbers from 1 to 200 in just 1 minute.

MESSAGE: Provide activities that make your students think and solve problem not just rote memorisation.

YOU might just be NURTURING OUR own EINSTEIN

What triggers thinking? QUESTIONING!

- In the thinking activity above,

  Did I provide CONTENT or CLUE?

  Did you get my message or not?

Did it make you ACTIVELY THINK or PASSIVELY receive my message?

Questioning is a skill used by teachers to engage and interact with students on a subject matter. It can prompt students' reasoning and guide them to observing certain phenomenon, demonstration activity or experiment. It prevents teachers from spoon-feeding their students on every topic but prompts students to be active participants in their learning. Puzzles and riddles are brilliant contextual way of engaging students in critical thinking; they can be used to question students to guide their thinking on a particular subject/topic. Riddles like: *Opa tinrin kan ile okan orun kini o*? Ojo – meaning: 'a thin staff reaches the sky and the earth, what is it? - Rain' to teach ecosystem. Trigger students while teaching ecosystem to explain why Yorubas will say "*a kii bu sango ni eerun*", no one abuses the sango deity in the dry season? Because no rain, nor thunder in the dry season, so it has no implication because thunder will not strike in rainless season. Use proverbs

that go along with concepts in Physics, Chemistry, Biology. '*Laalaa to roke, ile lo nbo*' - a Yoruba proverb explaining perfectly the 'Law of Gravity'. *Yoo bale, yoo bale ni labalaba fii wo igbo* – an incantation line describing the concept of gravity. *Iromi to n jo lori omi, onilu re wa nisale odo* - relating the upthrust that exists when a body is immersed in a fluid that's Archemedes principle in Physics. *Ayo okoto* – game of Oscillation. – What is the rationale?

Whenever you state a LAW in class? Do you allow your students to question WHY?

Our answer can't be – that is how the law is stated? QUERY why and discover the rationale.

MESSAGE: Let's create our own NEWTONs.

Look inward into students' lived experiences, relate them to concepts you teach, challenge them to think in that direction, generate inspiring activities to achieve curriculum content.

Sublimation – don't define

– Carry out experiment (shear butter, camphor, air freshener)

Let them record their observations and put up their own definition (students' diary)

Student-diary - rather than teacher's note develops students' constructive ability, it encourages them to develop their literary skill and better understanding of concepts taught. In activity-based or inquiry-based learning, students' observation should be noted themselves. Further explanation given by teachers would also be developed in their own language then, assessed by the teacher to clarify their misconceptions and wrong interpretation. In this method, students can retain the understanding of the concepts they formulated themselves compared to reading and memorising teachers' note. This method may be faulted for indolence on the part of the teacher. However, it requires more active teacher involvement in the students' work.

Don't Write Notes That Can Be Found in Textbooks or Even on the Internet

Flipping is a method that requires students to consult additional resources like Internet resources (video, audio or textual), or even educational television and radio programmes, on topics to be discussed later in class. They would be

given study guide and questions on what to focus on in the resources given. They could also be required to conduct some activities based on the content learnt in the resources and they will eventually develop their own notes from the resources reviewed. Thereafter in class, the teacher will spend the class time interacting with the students on the flipped material – discussing the study guide and questions, answering conflicting queries from students, analysing the activities given and assessing students' notes. This method ensures maximum and judicious utilisation of class time without any fear of not completing the subject syllabus.

At the Tertiary Level

Experiential Learning - Impactful Learning

- Picture this scenario –
    - 1. You heard about a ghastly motor accident
    - 2. You witnessed a ghastly motor accident
    - 3. You were involved in a ghastly motor accident, but THANK GOD!!! You SURVIVED.

What's the experience in each situation?

How long will the effect in each case last?

Which has the mostlLasting IMPACT?

MESSAGE: Create a more lasting IMPACT in every lesson

Chinese Maxim: What you hear, you forget; what you see you remember; but what you do, becomes part of you make your students active not passive

Outcome-Based Learning

Apprenticeship Approach

- Which do you prefer? 1 or 2?

1- A child learns auto-mechanics in 5 years, become a road-side mechanic-can fix any car. The best in town.

2- A child goes to university for 5 years, learn all theories of auto-mechanics-can't fix a loose bolt in his car.

Now, which is better 1 or 2?

- What's the point?

I learn all the laws of electricity but I can't apply it?

That's the question every student should ask you (Teacher/Lecturer)

Message- Help your students learn, apply and change the world for better.

Your student might be the next world celebrated inventor

Message: make your lessons concrete

We'll marvel at our discoveries

Theorists and law proponents in this field observed real life situations as they encountered them in practice and documented them for future references. What references will our future engineers leave behind if all they do is to study for grades? Quite pathetic that we roll out graduates with first class and second class upper year in year out without substances to show with the exception of a few though. As teachers, how do we turn around this situation? While we teach, let's create problems for students to solve. Just like a naughty young boy will break his father's radio and assemble it back, whether it works or not, he made an effort. After all, Thomas Edison tried to invent the light bulb 9999 times before he succeeded the 10,000th time. So, teachers should provide an avenue for their students to try and make mistakes; let them document all the trials and errors they make, what differ in each stage, in each trail. Perhaps, eventually, they will make an edge way. Not at every error would the teacher intervene, but we should provide further guide, tip or ask prompt questions that will channel a possible direction. As they venture into this discovery learning, they will consult previous textbooks, theories, laws; and the theoretical knowledge we teach in class will eventually be learnt along in their adventure. As they do this, it becomes part of their experience - not the 'la cram la pour' syndrome.

Seem quite Unrealistic? Pedagogical Implications of GLOCALISE Approach

- No time to complete the syllabus?
- No resources to achieve these?
- Too many students in class?

To achieve this seemingly unrealistic approach, Adedokun-Shittu, Abdulkabir, Nuhu, (2018) guided teachers on how to discountenance passive Learning Objectives (LO), create and focus on active SMART (Simple, Measurable, Attainable, Realistic and Timely) objectives, by subsuming the passive LOs under the active LOs and thereby achieving more than the curriculum stipulates. Avoid LOs like define concepts, list or state…, substitute with - demonstrate how the concept works in real life, explain the algorithmic process of achieving such concepts and describe a simple activity that explains the concept, design a game to enliven the concept, relate the concept to real life, day to day activities. When these higher order LOs are achieved, lower ones are automatically catered for.

Assessment also changes with the GLOCALISE Approach. The UNESCO International Bureau of Education IBE (2013) glossary of learners' assessment is adopted. "Assessment as learning" encourages learners to self or peer-reflect on their learning. "Assessment for learning" adapts the educational processes to meet learners' needs, identify learners' strengths and weaknesses and provide support to reinforce them. "Assessment of learning" in the form of standardised tests or centrally-set examinations to assess learners' achievement for certification is used to fulfil standardised education requirements and for GLOCALISE learners to compete favourably with their peers locally and globally. "Assessment of learning outcomes" uses varying methods - tests, oral or written, projects and portfolios to assess students' attainment of learning outcomes. GLOCALISE uses a reverse assessment by laying more emphasis on "Assessment of learning outcomes" as an integrative assessment approach by engaging students in problem/project-based activities, which systematically subsume other forms of assessment. A problem/project-based activity on a topic in class will have taken learners through assessment as learning through questions and activities that prompt self and peer reflection. Assessment for learning through provision of relevant GLOCAL support resources like proverb, artifacts, real life scenario, flipped resources from web links will reinforce learners' weaknesses and fortify their strengths on the concept. Students' observations noted in their diary will be verified with validated sources such as textbooks and web resources. All these would have prepared learners with the cognitive, affective and psychomotor abilities to intelligently solve any problem encountered in standardised tests no matter how craftly structured they are.

With the GLOCALISE approach, curriculum remains unsafe from changes. There is need for radical restructuring of the curriculum and deepening involvement from government, parents, school administrators and all stakeholders in education. Students and parents' active engagement is paramount; teachers become comfortable with a changing role as a coach and facilitator, no longer a sage on the stage and school administrators become understanding partners in this approach. Consequently, the nature of lesson plan, class structure and teacher-orientation changes, syllabus and curriculum restructuring become inevitable, textbook redefinition is crucial and definitely, assessment will not be limited to summative test and measurement, it becomes an all-inclusive learning and outcome-based assessment.

Higher Institutions and Community Service Role

The connection between town and gown in higher education provides community and collaborative services to transform our education sector to the tinkering sector for human and capital development. The iterative model in figure 1 explains the GLOCALISE Outcome-based Learning Strategy, which shows how the the Faculties of Education in our tertiary institutions should play a crucial role in training teachers across all levels of education to explore African culture for educational transformation. The Faculties are expected to give students perceptive hints and questions to encourage critical thinking, develop creative activities through problem/project based solutions, transform projects into prospects, thereby making African education meaningfully outcome-based.

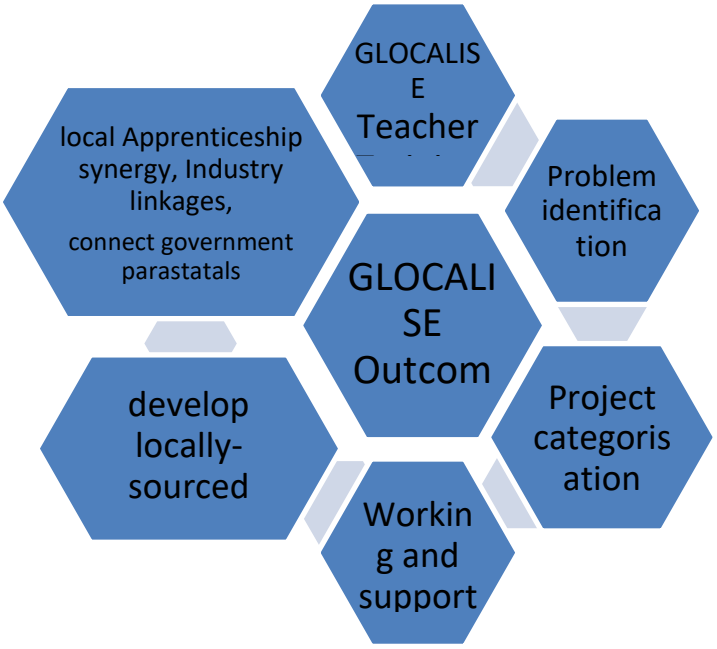


Figure 1: GLOCALISE Outcome-based Learning Strategy (GLOCALISE, 2023)

The GLOCALISE Strategy for achieving outcome-based learning thus should identify problems across society, form interdisciplinary working group, distribute tasks, create professional support groups, identify locally-sourced materials to develop prototype solutions, foster synergy with local skilled workers and upscale apprenticeship, link up with industries to provide support, then connect relevant government parastatals to adopt the outcome as a national achievement, and finally promote internationally, especially through social networks and global exchange programmes. This will monumentally impact on Quality Education as entrenched in the Sustainable Development Goal (SDG 4) of every community adopting GLOCALISE Outcome-based Learning Strategy.

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CHAPTER THIRTEEN

Empowering Visually Impaired Students: Developing Educational Assistive Technologies for Inclusion in the Nigerian University System

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Abstract

Students with visual impairments in Nigerian universities continue to encounter significant barriers to learning, including inaccessible educational materials, inadequate assistive technologies, insufficient institutional support, and limited educator preparedness for inclusive teaching. This paper presented a conceptual framework for promoting educational inclusion through the development of localised assistive technologies, accessible learning resources, educator capacity-building, and institutional policy reform. Drawing on Inclusive Education Theory, the Social Model of Disability, Universal Design for Learning (UDL), and the Capability Approach, the paper proposed an integrated model to enhance access to higher education for students with visual impairments. Central to the framework is EVISVision, an assistive mobile learning application designed to support independent access to educational content through text-to-speech, optical character recognition, voice navigation, and offline functionality. The framework also emphasised the conversion of academic materials into Braille, audio, large-print, and screen-reader-compatible formats, as well as systematic staff training and policy implementation. The paper contributed to the ongoing discourse on inclusive higher education and offered practical recommendations for advancing Sustainable Development Goals 4 and 10 through equitable access to quality university education in Nigeria.

Keywords: Inclusive Education, Assistive Technologies, Accessibility, Policy Reform.

Introduction

Inclusive education is an educational approach that identifies and removes barriers to learning, ensuring all students, regardless of ability or background, can learn together effectively (UNESCO, 2025). In Nigeria, as in many countries, inclusive education has gained prominence as a strategy to provide quality education for all and to address disparities in access. Visually impaired students represent a significant group that faces unique challenges in higher education. Visual impairment ranges from low vision to total blindness, affecting a person's ability to read standard print or navigate visual materials (Garcia, 2024). Globally, the scale of visual impairment is substantial, at least 90 million children worldwide live with some form of vision loss or blindness and Nigeria is no exception (89up, n.d.). An estimated 4.25 million Nigerians over age 40 have moderate to severe visual impairment or blindness, indicating the magnitude of need for accessible learning solutions (Dineen et al., 2006). Visual impairments can drastically impede students' educational experience by limiting their access to textbooks, lecture presentations, and other visual learning resources.

The push for inclusion is grounded in fundamental rights and international development agendas. Sustainable Development Goal (SDG) 4 calls for inclusive and equitable quality education and lifelong learning opportunities for all, explicitly including persons with disabilities in its targets (United Nations, n.d.). Similarly, SDG 10 aims to reduce inequalities by empowering and promoting the social inclusion of all, irrespective of disability status (Casey, 2020). Nigeria has affirmed these goals by adopting policies aligned with the UN Convention on the Rights of Persons with Disabilities (CRPD). For example, a 2017 national policy defines inclusive education as "the process of addressing all barriers and providing access to quality education to meet the diverse needs of all learners in the same environment" (UNESCO, 2020). In practice, however, many Nigerian students with disabilities remain excluded or struggle within universities, due to insufficient accommodations and support (UNESCO, 2020). This gap between policy and reality highlights the need for concrete interventions.

Assistive technologies and educator training are key strategies to bridge this gap. Modern digital tools have transformed how students learn, and assistive technology (AT) can be life-changing for those with visual impairments.

Research confirms that AT can significantly increase the inclusion and accessibility of students with disabilities in education (Fernández-Batanero et al., 2022). Screen readers, text-to-speech software, electronic Braille displays, and other innovations allow visually impaired learners to access information and participate more equally. Yet, studies also show that significant barriers persist - notably a lack of teacher training in using inclusive strategies and technologies, limited information about available AT, and infrastructural or accessibility challenges (Fernández-Batanero et al., 2022). In Nigeria's universities, many lecturers have never received formal training on inclusive education techniques, and assistive devices or materials are often scarce. Even well-intentioned inclusion policies cannot succeed without knowledgeable educators or available tools.

This paper addressed these challenges by focusing on four interconnected priorities: developing assistive learning technologies tailored to visually impaired students, training educators in inclusive pedagogy, adapting academic materials into accessible formats, and advocating for supportive institutional policies. The project aimed at creating an enabling environment that empowers visually impaired students by addressing technological and human factors. These efforts directly support SDG 4's mandate of inclusive education and SDG 10's call to reduce inequalities, helping ensure that a visual impairment is not a barrier to university success. The main goal of this paper is to provide a comprehensive plan for fostering an inclusive Nigerian university system where visually impaired students can thrive alongside their sighted peers.

Conceptual Framework

Inclusive Education Theory

Inclusive education theory posits that schools and universities should accommodate all learners by eliminating barriers and providing support in regular education settings. Rather than segregating students with disabilities, the inclusive model strives to modify the environment and teaching practices to suit diverse needs. According to UNESCO, inclusive education involves "reinforcing the capacity of education systems to welcome and reach out to all learners" (UNESCO IIEP, n.d.). It covers everything from adapting curricula and pedagogy to training teachers and redesigning physical spaces (UNESCO, 2025). In the Nigerian context, inclusive education is a key strategy for

achieving SDG 4 and ensuring equitable education. National policy now frames inclusion as addressing all barriers (physical, informational, attitudinal) that impede any learner (UNESCO, 2020). This theory guides the project's holistic approach – rather than expecting visually impaired students to "fit" into an unaccommodating system, the system must change. All components of the university environment (course materials, teaching methods, infrastructure, policy) should be made accessible. The emphasis is on equal participation: visually impaired students learning alongside sighted peers, with appropriate supports in place. By grounding the project in inclusive education principles, we aim to foster an academic culture that respects diversity and provides "the same opportunities to participate in society as their peers" for students with disabilities (Fernández-Batanero et al., 2022).

Social Model of Disability

This project is also informed by the social model of disability, which distinguishes between an individual's impairment and the disabling barriers imposed by society. Under the social model, people are *not* disabled by their medical condition per se, but by external obstacles – e.g. inaccessible buildings, lack of assistive tools, or prejudiced attitudes (Disability Equality in Education, n.d.). In other words, disability is a product of the interaction between individuals and their environment. A visually impaired student has a functional vision limitation, but whether that becomes a "disability" in education depends on social arrangements. A rigid curriculum that assumes all students can read standard print, or a library without screen-reading software, creates disability by preventing that student from fully participating (Disability Equality in Education, n.d.). The social model calls for removing these barriers to create equality and offer disabled people more independence, choice and control (Disability Equality in Education, n.d.). Applying this lens, the project focuses on fixing the environment – providing assistive technology, accessible materials, and inclusive teaching – rather than "fixing" the student. For example, if a textbook is only available in regular print, a blind student is disabled by that format; but converting the book to Braille or audio removes the barrier, and the student can learn on equal footing. The social model of disability thus underpins our advocacy for institutional policy: universities must change policies and allocate resources to accommodate diverse needs. It also fights the stigma that "disabled people cannot do certain

things" by demonstrating that with the proper support, visually impaired students can excel (Disability Equality in Education, n.d.). Embracing this model, the project treats accessibility and inclusion as collective responsibilities of the university system.

Universal Design for Learning (UDL)

Universal Design for Learning (UDL) is a framework that translates inclusive education into practical instructional design. Originating from architecture's universal design concept, UDL asserts that educational materials and methods should be designed from the outset to accommodate a wide range of learners, rather than retrofitting accommodations later. Sharma et al. (2023, p.34) defined UDL as "an educational framework that aims to create inclusive learning environments by providing multiple means of representation, action and expression, and engagement for all students, regardless of their learning styles, abilities, or disabilities." UDL encourages teachers to present information in various ways (visual, auditory, tactile), allows students multiple ways to demonstrate knowledge, and uses diverse strategies to engage and motivate. By proactively removing learning barriers and offering flexibility, UDL reduces the need for individual special accommodations (Sharma et al., 2023). This project incorporates UDL principles in training educators and adapting curricula. For instance, converting materials into Braille, audio, and high-contrast large print ensures multiple content representations, benefiting visually impaired students and others. Likewise, the EVISVision app with its voice navigation and text-to-speech features provides alternate means of accessing content and completing tasks. UDL also stresses an inclusive digital learning environment: our plan to create accessible e-books and screen-reader-friendly documents aligns with making the digital course space navigable to all. By guiding lecturers in UDL-based lesson planning (e.g. always describing visual aids orally, providing lecture notes ahead of time in accessible formats), we institutionalise inclusive practices. Consequently, UDL serves as a design checklist to ensure all project outputs – whether a piece of software, a teaching guide, or an assessment method – are as usable by the broadest range of students. This contributes to sustainable inclusion beyond the project's direct beneficiaries.

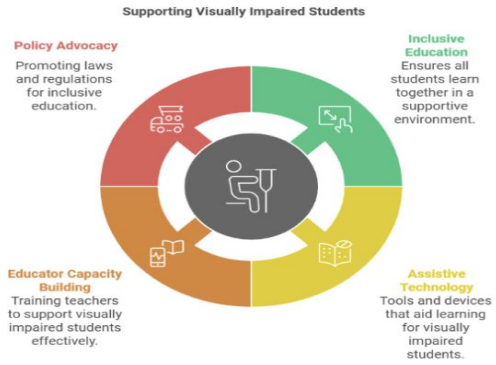
Capability Approach

Another conceptual pillar for this project is Amartya Sen's Capability Approach, particularly regarding disability and education rights. The capability approach focuses on expanding what people can be and do – their substantive freedoms or "capabilities" – rather than just providing resources. In the context of persons with disabilities, this approach argues that true equality entails enabling individuals to achieve functionings they value (such as obtaining a university education or pursuing a career), not merely treating everyone equally. As Broderick (2018) noted, the capability approach "focuses on ensuring equality and developing human potential," offering a way to move beyond traditional measures of educational equality that only count inputs or test scores (Broderick, 2018). Applying this to inclusive education, we ask: do visually impaired students have the capability to succeed in higher education equally? If a blind student has a right to education but cannot access textbooks or campuses lacking Braille materials, their freedom to learn is curtailed. The capability approach thus supports providing assistive technology, alternative formats, and supportive teaching as essential to expanding a student's freedoms. It aligns closely with Article 24 of the CRPD, which guarantees persons with disabilities the right to education and requires states to facilitate their "full development of human potential and sense of dignity and self-worth" (Broderick, 2018). By giving visually impaired students the tools (capabilities) to learn independently – e.g. an app to read any text aloud, or training that enables teachers to include them in class discussions – we enhance their agency and educational outcomes. This approach also informs our evaluation: success is measured by the extent to which students can perform academic tasks and participate in university life, rather than just the provision of equipment. The capability lens reinforces that quality education for disabled students is a matter of justice and empowerment, not charity. Therefore, each component of our project (technology, training, materials, policy) is aimed at removing conversion handicaps and unleashing the capabilities of visually impaired learners to achieve their academic and life goals.

Interconnection of Technology, Training, and Policy

Crucially, these frameworks are interconnected in practice – technology alone cannot foster inclusion without trained educators and supportive policies, and

vice versa. The conceptual model driving this project sees assistive technology development, educator capacity-building, and policy advocacy as synergistic strategies that must work together. For example, the social model and UDL indicate that simple introduction of an assistive device (screen-reading software) is insufficient if instructors do not know how to integrate it into teaching or if university rules do not mandate its availability. Likewise, teacher training on inclusive methods will have limited impact if appropriate tools or materials are not available to implement those methods. Thus, the project adopts a systems approach: technological solutions (EVISVision app, accessible format materials) are deployed alongside human solutions (training, disability support services) within an enabling institutional framework (policies and funding).



(Figure 1: Conceptual model linking assistive technology, educator training, and inclusive policy for empowering visually impaired students)

Figure 1 (conceptual diagram) illustrates this interplay: the visually impaired student is at the centre, surrounded by three support pillars – technology, pedagogy, and policy. *Technology* (such as the EVISVision app and Braille/audio textbooks) provides access; *teacher training* ensures the pedagogy adapts to include the student using those means; and *policy* provides the mandate and resources to sustain both the technology and inclusive practices across the institution. If any pillar is weak, inclusion may fail. Findings in the literature support this integrated approach. Fernández-Batanero et al. (2022) emphasise that while assistive technologies improve inclusion, barriers like insufficient teacher training and lack of information can undermine their effectiveness (Fernández-Batanero et al., 2022).

Correspondingly, a policy brief on inclusive education management in Nigeria found that improving inclusion requires adequate teacher training, provision of teaching resources, and strong policy support, including proper funding (Nwakudu & Oliobi, 2021). Our conceptual framework, therefore, treats the development of AT, educator training, and advocacy for institutional policy as three strands of a single braided rope – all necessary to pull the system towards true inclusion. This theory of change guides the research methodology and implementation plan described next.

Methodology

The project employed a mixed-methods research design combining qualitative and quantitative approaches to achieve the stated objectives. This comprehensive methodology was structured in several phases: Needs Assessment (Qualitative and quantitative), Development of Localised Assistive Technologies (Design Research), Pilot Testing and Evaluation (Mixed Methods), Policy Advocacy, and Stakeholder Engagement.

Throughout all phases, ethical consideration was paramount. Informed consent was obtained from all student and staff participants, with assurance of confidentiality and the right to withdraw from the study at any time. Research involving vulnerable populations (students with disabilities) were approved by institutional ethics committees and conducted in accordance with international ethical standards. Feedback loops was incorporated; and preliminary findings were shared with participants and stakeholders for validation (member checking), ensuring the research accurately represented their perspectives and needs.

Expected Outcomes

Deployment of the EVISVision Assistive Mobile Learning App

A fully functional mobile application (with companion desktop and web versions) will be launched and made available to students. The app, described below, will enable visually impaired learners to access digital content through text-to-speech and other features. We expect at least 100 visually impaired students to be actively using EVISVision by the end of the project's pilot phase, with expansion in subsequent semesters. The app will be open-sourced and freely available, allowing further adoption by other universities and integration of additional features over time.

Conversion of Academic Materials into Accessible Formats

At least 20 core textbooks and numerous course handouts across different disciplines will be adapted into Braille (both embossed and refreshable digital Braille), audio (narrated or text-to-speech MP3), large-print, and screen-reader-friendly electronic formats (such as accessible PDF, EPUB3 or DAISY books). This includes foundational texts in subjects like law, psychology, literature, and science, which were identified as high-priority by the student needs assessment. The converted materials will be catalogued in an Accessible Educational Materials (AEM) repository within each pilot institution's library, creating a lasting resource. For example, if a Political Science textbook in print is converted to Braille and audio, future blind students can readily obtain those formats without delay. By the end of the project, visually impaired students in the pilot universities should be able to access all their semester readings in at least one accessible format.

Enhanced Capacity of Educators and Staff (200+ trained)

Over 200 lecturers, instructors, and academic support staff will receive training in inclusive education practices and the use of assistive technologies. This includes those who attended our intensive workshops, plus additional faculty reached through departmental training sessions and online modules developed by the project. We anticipate a measurable improvement in educators' attitudes and self-efficacy regarding teaching students with disabilities. For instance, post-training surveys are expected to show significant gains in participants' confidence to adapt materials or utilise tools like screen readers. Each trained educator becomes an ambassador for inclusion within their faculty. In the long run, this growing cohort of sensitised and skilled staff will foster a more inclusive campus culture and ensure that gains are not lost when the project concludes.

Institutional Adoption of Inclusive Education Policies

A critical outcome is achieving institutional and policy changes that embed support for visually impaired students into the system's fabric. We aim to have at least a few partner universities formally adopt new policies or guidelines due to our advocacy. Examples include: establishing a Disability Services Unit on campus (with at least one staff coordinator appointed to assist students with special needs), including provisions for accessible infrastructure and materials in the university's strategic plan, or signing an

MOU with the project team/NGOs to continue providing assistive technology support after the grant period. At the national level, we seek acknowledgement of our model in policy discourse – for instance, influencing the Federal Ministry of Education to incorporate our training curriculum into national teacher training programmes, or securing budgetary commitments for assistive devices in tertiary institutions. Success would be indicated by concrete actions such as a government directive urging all universities to implement the 2017 Inclusive Education Policy and report on progress, or by additional funding streams (from government or donors) dedicated to scaling the project outcomes. Overall, the objective is to move from isolated interventions to institutionalised inclusion.

EVISVision: Assistive Mobile Learning App

One of the project's flagship innovations is the development of **EVISVision**, an assistive mobile learning application designed to support visually impaired students in Nigeria's university system. The name "EVISVision" stems from Empowering Visually Impaired Students through Vision technology, reflecting its core purpose of opening educational content to those without sight.

Purpose and Concept

EVISVision is a personal learning companion for visually impaired students, turning a standard smartphone into a multi-functional assistive device. The app addresses everyday challenging academic tasks for blind or low-vision learners, such as reading textbooks, scanning printed handouts, navigating campus information systems, and controlling digital interfaces, by providing seamless audio and tactile (via vibration or optional braille display) interactions. The overarching goal is to enable students to study and navigate educational materials independently, without always needing a human reader or aide. By leveraging the ubiquity of mobile phones, EVISVision offers a low-cost, portable solution that can be widely adopted. Importantly, it is localised to the Nigerian context: it supports Nigerian English accents and Pidgin (for text-to-speech and voice commands). It is tuned for the content Nigerian students encounter (for example, it can correctly pronounce local names or places in texts).

Key Features

Screen Reading & Text-to-Speech (TTS): The app can read aloud digital text content, such as e-books, PDFs, Word documents, or web pages. Students can load their lecture notes or digital textbooks into EVISVision, and the built-in TTS engine will convert the text to clear spoken audio in a natural-sounding voice. The reading speed, voice pitch, and language accent are adjustable. This feature transforms any electronic document into an audiobook on demand, enabling visually impaired students to listen to their study materials. For instance, a student can listen to a PDF article on their phone while commuting or revise lecture slides by having them narrated by the app. (This is akin to mainstream screen reader software on computers, but optimised for mobile and academic use.) The importance of such technology is well-documented – tools like screen readers have revolutionised access to information for blind individuals (Australian Disability & Community Education & Training Ltd, n.d.). EVISVision extends this to the mobile learning context.

Optical Character Recognition (OCR): A standout feature of EVISVision is its OCR capability, which allows users to convert printed text into speech. Using the phone's camera, a student can snap a photo of a printed page – e.g. a textbook, class handout, or library article – and the app will analyse the image to recognise the text and then read it aloud. This empowers students to access print materials not previously available in Braille or digital form. For example, if a professor distributes a paper handout in class, a visually impaired student can use EVISVision to scan and listen to it immediately, rather than waiting for a transcribed version. The app provides audio guidance for capturing images (e.g. it can speak prompts like "move camera to the left" to help the user position the page correctly, similar to features of the KNFB Reader) (Australian Disability & Community Education & Training Ltd, n.d.). The OCR feature, which works offline once the language pack is downloaded, is crucial in a developing context where internet access may be unreliable. By bridging the gap between physical print and digital audio, EVISVision significantly reduces dependence on sighted assistance for reading.

Voice-Controlled Navigation: EVISVision is built to be used *eyes-free*. Users can navigate the app's functions and device using voice commands or simple gestures, minimising the need to look at or precisely tap the screen

(which is difficult for blind users). The app recognises spoken commands for everyday actions – for instance, a student can say "open Biology textbook Chapter 3" or "search for Introduction to Economics in the library" and EVISVision will execute the command. It also has an interactive voice assistant mode to answer queries like "what are my reminders?" or "go to page 50." Additionally, through integration with the phone's accessibility services, EVISVision allows voice or gesture control of other apps (for example, controlling a slideshow or recording). This not only aids in app usage, but also helps with general smartphone accessibility for academic tasks. For instance, a student can dictate an SMS or email to a lecturer, or ask EVISVision to announce incoming notifications, ensuring they stay connected with class communications. The voice interface is crafted to understand Nigerian English accent and common phrasing, making it user-friendly for local students.

Multi-Platform Support (Android, iOS, Web): Recognising that students may have different devices, EVISVision is being developed for Android (the most common smartphone OS in Nigeria) and iOS, with a web-based version for use on laptops or library computers. The core functionality remains consistent across platforms. A student could use the phone app on the go and log into EVISVision on a computer in a campus ICT centre to access the same features (screen reading, etc.) on a larger screen or with a hardware braille display. Synchronisation features allow notes or bookmarks to be shared across devices. This cross-platform approach ensures no student is left out due to device type and allows integration into university computer labs.

Offline Functionality: Given unreliable internet connectivity in many regions and the cost of mobile data, EVISVision is designed to work predominantly offline. After initial installation and downloading of necessary language packs and libraries, features like OCR and TTS operate without needing the internet. Students can use the app in remote campus areas or at home without connectivity. Cloud-based features (such as backing up user notes or downloading additional voices) are optional. This offline-first design is a practical necessity in the Nigerian context and ensures the tool is accessible to students regardless of their connectivity situation.

Localisation and Academic Integration: The app includes features specifically for academic use: an academic calendar and reminder system

(students can receive spoken reminders of class times, assignment due dates, or exam schedules), a feature to navigate by headings or page numbers within textbooks easily, and compatibility with library systems (potentially allowing students to search their university's library catalogue via the app). By collaborating with university libraries, we aim for EVISVision to serve as a portal to accessible library resources eventually. Sustainability is also built by making the app open-source – the code and documentation are publicly available so that university IT departments or local tech communities can contribute to its maintenance and improvement. The project is working with campus tech clubs and international NGOs to build a community of developers who will keep EVISVision updated and free. The open-source nature also fosters ownership: Nigerian universities can customise the app (e.g. add specific course materials or modules) to best serve their students.

Sustainability and Support: For EVISVision to have a lasting impact, plans are in place for ongoing support. The app will be institutionalised through university adoption – we are advocating that partner universities formally endorse the app as a recommended learning aid for students with visual impairments. Ideally, each university would have an ICT officer or disability support staff trained in the app's use, who can assist new students in onboarding and handle any technical issues. We have also partnered with a Nigerian tech NGO focusing on accessibility; they have agreed to host the open-source project repository and coordinate volunteer contributions post-project. Moreover, we are exploring collaborations with corporate sponsors (such as telecom companies or tech firms) to fund future development or possibly bundle the app on devices provided to students. The goal is for EVISVision to continue evolving beyond the initial project, adding features like STEM equation reading, integrating with braille notetakers, or incorporating AI for smarter image descriptions, thereby continually empowering new cohorts of visually impaired students.

Textbook & Academic Material Conversion Process

In tandem with developing new technology, the project strongly emphasises converting and producing accessible academic materials. Accessible Educational Materials (AEM) are instructional resources reformatted or designed to be usable by the broadest range of student abilities (CAST, n.d.). For visually impaired students, the main formats of interest are Braille, audio,

large print, and navigable e-text. Our conversion process is designed to yield materials in all these formats, ensuring redundancy and preference matching (since students have varying needs and preferences – some may be fluent Braille readers, others prefer audio, etc.). The process involves collaboration among subject matter experts, assistive technology specialists, and professional transcribers. Key formats and steps include:

Braille (Digital and Embossed)

Braille remains a crucial medium for many blind scholars, especially for detailed reading and technical subjects (where spelling, punctuation, or notation is important). Our team uses Braille translation software to convert text into Grade 2 Braille code, followed by proofreading by certified Braille transcribers for accuracy. The output is provided in two ways: (1) Digital Braille files (Braille-ready files like BRF or BRL) which students can read using a refreshable Braille display or on a computer with Braille support, and (2) Embossed Braille hardcopies for key textbooks or materials, produced with a high-speed Braille embosser on durable paper. For example, if "Introduction to Economics" is a 300-page print textbook, it might become roughly 10 volumes of embossed Braille. We prioritise producing Braille for materials like math/statistics content, where tactile reading of equations or tables is beneficial. Braille production follows international and Nigerian Braille standards (BANA guidelines for literary Braille, Nemeth Code or UEB for mathematics as appropriate). Each pilot university's resource centre will house a Braille library of commonly used texts by the project's end. Even though Braille preparation is time-consuming, it is invaluable for building literacy and note-taking skills among blind students.

Audio Format (Synthetic and Human-Narrated)

We provide audio versions of materials to cater to students who learn best by listening. Our approach leverages high-quality text-to-speech conversion and human narration in some cases. Using the EVISVision TTS engine and other software, we generate audio files (MP3 or DAISY audio books) for textbooks and lecture notes. These automated readings are quick to produce and can be easily updated if the source text changes. We also employ human narrators to record audiobooks for particularly complex or narrative-heavy texts (for instance, literature readings or materials where tone is important). We partner with volunteer reader programs and radio/television voice artists to record

chapters of select texts in clear, expressive speech. All audio materials include structured navigation (e.g. the ability to skip by chapter or section, especially in DAISY format). Students can either listen through the EVISVision app or via any MP3 player. The audio format allows students to study while commuting or resting, and can be a less intensive way to absorb large volumes of text. It addresses the finding that assistive technology can help with reading and writing challenges, enabling students to engage with content in a mode that suits them (Okoye, 2024). The project expects to produce dozens of hours of instructional audio content, benefiting others with reading difficulties.

Large Print and High-Contrast Materials

We create large-print versions of documents for low-vision students (those with some usable vision but who need magnification). Using desktop publishing tools, we reformat textbooks or handouts into large font sizes (e.g. 18-24 point) with high-contrast colour schemes (typically white text on black background or black on pale yellow, depending on user preference). These are PDF files optimised for screen magnifiers or printed on paper for shorter handouts. We ensure that diagrams or images in the material are enlarged and clarified with good contrast. Large-print materials help partially sighted students who might find Braille unfamiliar and prefer to use their residual vision. Additionally, we encourage using tactile graphics where appropriate: diagrams, maps, or charts are reproduced using swell paper or embossed outline drawings so blind students can feel the shapes. While tactile graphic production is specialised, we have created a few (for example, a tactile diagram of the human anatomy for a biology course, or a raised-line graph for an economics course) as prototypes. We will train staff to produce more on demand. These efforts align with recommendations that accessible formats include not just text but also graphical information in tactile form (CAST, n.d.).

Screen-Reader Compatible Digital Files

Ensuring electronic documents are structured adequately for screen reader software is vital to our process. This includes producing EPUB3 or DAISY text versions of textbooks, which are essentially e-books with built-in accessibility. For instance, an EPUB3 file can contain headings, navigation landmarks, alt-text for images, and descriptions, allowing a blind student to jump to chapters or have figures described easily. DAISY (Digital Accessible

Information System) books provide a similar navigable structure, often used in specialised talking book libraries. We have converted materials into accessible Word and PDF formats, tagging headings, lists, tables, and adding descriptions to images so that commonly used screen readers (like NVDA or JAWS) can interpret them correctly. This ensures that students who prefer using their laptop with a screen reader can read the material without obstacles. According to the National Centre on Accessible Educational Materials, examples of accessible formats include "audio, braille, large print, tactile graphics, and digital text conforming with accessibility standards" (CAST, n.d.) Our project covers all of these. Screen-reader-friendly e-text is perhaps the most versatile format, as it can be rendered in audio, Braille or enlarged visually depending on the user's device. We expect that the accessible digital files we create will also be shareable resources; for example, if one university converts a popular textbook into an accessible e-book, it can be distributed to others, maximising impact. Part of our process is documenting conversion workflows so university libraries can continue producing such formats beyond the project.

Workflow and Collaboration

The conversion process generally follows these steps: obtaining permission and source files from publishers (when needed) – we leverage educational exemptions and fair use provisions where possible; running OCR on print-only materials to get a base text (proofread for accuracy); formatting the text for each output (Braille translation, adding image descriptions, etc.); quality checking each format with actual users (e.g. having a blind student test-read a Braille sample or having a low-vision student review a large-print layout); and finally, dissemination of the accessible copies through a library system or the EVISVision app. We have engaged with the Accessible Book Consortium and local blindness organisations to ensure adherence to best practices and to possibly contribute our outputs to broader initiatives like Bookshare or the Marrakesh Treaty libraries. By the end of the project, the aim is not only to have created a repository of accessible academic materials in pilot subjects, but also to have established a replicable model (guidelines, training for transcribers, and possibly procurement of equipment like Braille embossers) so that each institution can continue converting new materials each semester.

Conclusion

Promoting inclusive higher education for students with visual impairments requires more than policy declarations; it demands deliberate investment in accessible technologies, inclusive pedagogical practices, institutional commitment, and sustained stakeholder collaboration. This paper presented a comprehensive framework for addressing barriers faced by visually impaired students within Nigerian universities through the integration of assistive technology development, educator training, accessible learning materials, and policy advocacy.

The proposed EVISVision application demonstrates how locally relevant technological innovations can enhance independent learning and improve access to educational resources. Similarly, the conversion of academic materials into accessible formats and the strengthening of educator competencies can significantly improve participation and academic success among students with visual impairments.

For sustainable impact, universities should institutionalise disability support services, allocate adequate funding for assistive technologies, and incorporate inclusive education principles into strategic planning and staff development programmes. Policymakers should also strengthen the implementation of existing disability and inclusive education policies to ensure equitable access to quality higher education.

Ultimately, achieving an inclusive university system in Nigeria is both a social justice imperative and a developmental necessity. By removing barriers and expanding educational opportunities, Nigerian universities can create environments where students with visual impairments are empowered to realise their full academic and professional potential.

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CHAPTER FOURTEEN

Reimagining Leisure Education Through Freire: A Comprehensive Guide

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Abstract

This paper examines Paulo Freire's Pedagogy of the Oppressed as a transformative framework for leisure and recreation education. Traditional pedagogical approaches in leisure studies remain rooted in hierarchical, banking models that reinforce systemic oppression, including Whiteness, monoculturalism, and exclusion. Drawing on Freire's concepts of critical consciousness, dialogical action, and problem-posing education, we argue that leisure educators must move beyond performative inclusion toward genuinely liberatory practices. We analyse how current pedagogies perpetuate oppression through White Institutional Presence and anti-dialogical actions such as conquest, divide and rule, manipulation, and cultural invasion. We then demonstrate how Freirean dialogical actions, cooperation, unity, organisation, and cultural synthesis can address these inequities through co-creation, praxis, and decolonised pedagogy. Practical strategies include co-designed syllabi, community-engaged projects, and integration of Indigenous knowledge systems. By cultivating critical consciousness and embedding dialogical action, leisure educators can position education as a practice of freedom, challenging dominant ideologies and creating more inclusive, just learning environments.

Keywords: Critical Pedagogy, Freirean Dialogical Action, Leisure Studies, Whiteness and Praxis

Introduction

In recent years, educators across many fields have started to question traditional teaching methods. They have asked whether old approaches actually help students learn or whether they simply maintain unfair systems. Critical pedagogies offer teachers meaningful ways to connect with students through their real-life experiences. These approaches can create learning environments that include everyone and help set people free. However, in the field of leisure and recreation studies, most teaching still follows old patterns. Teachers talk, students listen.

Knowledge flows in one direction. Content is standardised and does not account for different backgrounds and experiences. This absence of critical frameworks is not neutral. It actually reinforces systems of oppression that are built into higher education itself. These systems include Whiteness, monoculturalism, and exclusion (Anderson et al., 2021; Mowatt, 2017).

Many scholars have written about these problems. Rose and Paisley (2012) and Theriault (2023) have pointed out how leisure education often ignores race and power. They have shown how traditional methods can hurt students from marginalized backgrounds. But while the literature has grown, few works have offered specific teaching approaches to counter these problems (Fernandez et al., 2022). This gap matters because identifying problems without offering solutions can leave educators feeling stuck. They may want to change but not know how. This paper aims to fill that gap by examining Paulo Freire's famous book *Pedagogy of the Oppressed* as a framework for reimagining leisure education. Freire was a Brazilian educator who developed his ideas while teaching poor adults to read in the 1950s and 1960s. He saw education as a practice of freedom rooted in dialogue, reflection, and action. His work provides powerful tools for confronting dominant ideologies and centering student agency.

We argue that leisure and recreation educators must move beyond performative inclusion efforts. It is not enough to add a few diverse readings to the syllabus or to mention inequality in passing. Instead, educators need to adopt teaching practices based on Freirean principles. This means fundamentally rethinking the relationship between teacher and student. It means creating classrooms where knowledge flows in both directions. It means treating students as whole human beings with valuable experiences and insights. We will draw connections between Freire's theory and common practices in leisure classrooms. We will critically examine how current approaches perpetuate oppression. We will then show how Freire's work can lead to more just and transformative models of teaching and learning. Our analysis concludes by offering specific strategies for embedding dialogical action into leisure education. The goal is to cultivate critical consciousness in students and create systemic change in the field.

Understanding Paulo Freire's Pedagogy of the Oppressed

To apply Freire's ideas to leisure education, we first need to understand what he actually taught. Paulo Freire was not just an academic philosopher. He was a practitioner who worked directly with oppressed communities. He saw education not as a neutral activity but as a political act that could either maintain or challenge existing power structures. His most famous book, *Pedagogy of the Oppressed*, was first published in Portuguese in 1968, and the English translation appeared in 1970. It

has since become one of the most influential works in educational theory. The book addresses the tension between freedom and the means through which freedom is achieved. At the heart of Freire's work is the concept of *conscientização*, or critical consciousness. Through critical consciousness, oppressed people become aware enough of their oppression to question and fight their reality. This awareness is not just intellectual. It is practical and emotional. It moves people from passive acceptance to active resistance.

Freire (1970) begins his book by examining what it means to be human. He argues that systems of oppression hinder human development. The oppressor tries to reduce the oppressed to less than human. The oppressed, in turn, see themselves as inferior and self-deprecating. This dynamic is destructive for everyone involved. However, both groups need each other to change this situation. The oppressor cannot truly help the oppressed without their involvement. The oppressed must be full participants in their own liberation. And in doing so, they also liberate their oppressors from their own dehumanisation. Freire (1970) writes that "the pedagogy of the oppressed is an instrument for their critical discovery that both they and their oppressors are manifestations of dehumanisation" (p. 48). He also makes clear that the oppressed must enter into reflection and critical consciousness as full human beings, not as objects. They are not problems to be solved, but people with agency and dignity.

In the second chapter, Freire outlines two distinct pedagogical models. The first is the banking model of education. This model assumes that learners are empty vessels ready to be filled by the teacher with knowledge and facts. The teacher deposits information, and the student receives it passively. Freire (1970) believes this pedagogy keeps students oppressed. It stifles their curiosity and creativity. It rewards meekness and receptivity. Students learn to accept authority without question. The banking model may seem inclusive because it offers education to everyone. But the content of banking often conflicts with the lived experiences of oppressed people. It presents a single-sided view of knowledge that normalises their lack of humanity. Students may be educated, but they are not liberated. They simply learn to fit into the existing system.

The second model is the problem-posing model of education. This is what Freire refers to as critical pedagogy. Instead of depositing knowledge, this method focuses on cognitive interactions between the teacher and learners. Knowledge is co-created. The flow of knowledge is reciprocal. Teachers and students teach each other. This dynamic process is only possible through dialogue. Freire (1970) writes that "problem-posing education affirms men and women as beings in the process of becoming, as unfinished, uncompleted beings in a likewise unfinished reality" (p. 84). This highlights the power of education as a means of liberation. It treats humans as always growing and changing. It also treats reality as something that can be

transformed. This model increases humanity and, as Freire often mentions, is an act of love.

The third chapter explores the key concepts of dialogic and anti-dialogical methods, the use of praxis, and thematic investigation. Freire believes these concepts are prerequisites for meaningful problem-posing education. Dialogue, for Freire, is not just conversation. It is "the encounter between men, mediated by the world, in order to name the world" (Freire, 1970, p. 88). Through dialogue, humans name their reality and enter into the process of becoming more fully human. The prerequisites for dialogue are love for the world, humility, faith, trust, hope, and critical thinking. Dialogue is positioned as the action associated with liberation. It is not a means to convince the oppressed to take action. It is itself a liberating act.

Freire (1970) also emphasises the need for thematic investigation before dialogical education can commence. Teachers must understand students' reality. Only then can they provide meaningful education. With an understanding of reality, teachers can help students investigate their own situation. This new awareness of limit-situations enables students to view their themes or situations as problems ripe for further investigation. They can see that their circumstances are not fixed but can be changed. This awareness is the foundation for action.

The fourth and final chapter lays out Freire's cultural action theory. He contrasts the methods of cultural change with cultural oppression by describing the theories of dialogical and anti-dialogical actions. The methods of anti-dialogical action include conquest, divide-and-rule, manipulation, and cultural invasion. Conquest aims to mythologise the world to maintain the status quo. It repeats to the oppressed the belief that the world is fixed and cannot change. Divide and rule focuses on helping individuals escape oppression rather than uniting people as a group. Individuals are lifted out of oppression only to return to their communities to propagate control. Manipulation asserts the possibility of class ascent. It distracts the oppressed from the reality of their oppression by promising them the chance to become elite. Cultural invasion imposes the ideas and values of the oppressor elite on the oppressed. It convinces the oppressed that their own ideas and values are inferior.

Freire (1970) then contrasts these with dialogical actions. These include cooperation, unity, organisation, and cultural synthesis. Cooperation exists only through communication. It utilises dialogical methods and problem-posing education, which leads to critical analysis of reality. Unity refers to the union of revolutionary leaders with the oppressed. This is resolved through praxis, the dialogue of thought that leads to liberating action. Organisation is a process that requires freedom and authority. It is established by transforming reality. Finally, in cultural synthesis, the leader's

worldview and the people's worldview are reconciled. The culture itself is confronted, and integration of the people toward action and liberation occurs.

Problematic Pedagogies in Leisure Education

The implementation of Freirean pedagogy in leisure and recreation studies offers opportunities to counter problematic pedagogies. These problematic pedagogies are connected to Freire's anti-dialogical action theory. They represent oppression in education. Central to these problematic pedagogies is the ideology of Whiteness, which is embedded in many structures of higher education. This ideology aligns closely with Freire's concept of the oppressor class. It highlights the dominant, pervasive systemic impact on education.

Scholars have developed frameworks to understand how Whiteness operates in higher education. Gusa (2010) uses the ideologies of Critical Race Theory, the worldview of Whiteness, and White privilege to construct their framework of White Institutional Presence (WIP). This framework has four characteristics: White ascendancy, monoculturalism, White blindness, and White estrangement. These four characteristics align with Freire's anti-dialogical theory of cultural oppression. Each one represents a way that white supremacy is maintained through educational practices. Understanding these characteristics is essential for leisure educators who want to create more just classrooms.

White ascendancy describes the opportunities and positions that a white sense of superiority can attain and maintain. In Freire, this is exemplified by manipulation, in which the oppressor convinces the oppressed of their ability to ascend to the elite class. We observe this conundrum in leisure and recreation studies. The continued use of certain narratives and pedagogies necessitates adaptation to be successful in the field. Several examples illustrate this point. The juxtaposition of wilderness and the use of natural spaces often reflect white values. The use and importance of challenge, as well as physical and social discomfort, also stem from white perspectives. The assumptions of leisure time and freedom ignore the reality that many people do not have the same access to free time or safe spaces (Peterson & Chenault, 2023).

Scholars have critically examined how dominant narratives in outdoor education are rooted in Whiteness. Ho and Chang (2022) examine how narratives tied to wilderness, risk, and self-discovery often exclude or alienate people of colour. Leisure spaces are framed as belonging to an imagined, racially neutral outdoors. But this neutrality is a fiction. Concepts like nature or wilderness function as gatekeeping tools. They limit access and a sense of belonging for marginalised communities. When educators treat these concepts as universal, they reinforce white ascendancy

without even realising it. Rose and Paisley (2012) similarly argue that outdoor education must critically examine its white-centered assumptions.

Monoculturalism describes the uniform set of values and beliefs embedded in white culture. These stifle true diversity in both scholarly work and campus climates. In Freire, this is described as cultural invasion. Cultural invasion similarly stifles creativity and diversity of ideas among the oppressed. The values and beliefs of the oppressors become predominant. Those of the oppressed are often viewed as inferior. In leisure studies, monoculturalism appears in how experiences are understood and constructed. Kivel and colleagues (2009) apply the concept of monoculturalism in leisure through a discussion of how the understanding and meaning of experiences in leisure are constructed. Researchers often use constructivist approaches that focus on the majority of people's perspectives. They ignore or marginalize other ways of knowing. These ideas are grounded in Gramsci's theory of hegemony (Cassar, 2017). Hegemony shows how dominant ideologies control narratives by continuing practices of exclusion and inequities under the cover of freedom and choice.

In an outdoor setting, monoculturalism is exemplified through the values that guide our interactions with nature and wilderness. Land-use ethics taught to practitioners often reflect white perspectives. Indigenous ways of relating to the land are ignored or treated as lesser. This imposes a single worldview on everyone. It tells students that there is only one correct way to think about nature, recreation, and leisure. This is cultural invasion in practice.

White blindness describes the tendency for race to be erased. With this erasure comes a lack of acknowledgement of racism. In Freire, we see the concept of conquest, which aims to mythologise the world as a fixed entity (DeBrew et al., 2024). When the oppressed cannot see their existence as anything but the current perceived reality, they cease to imagine anything different. This blindness to their own oppression is characteristic of the purpose of conquest. In leisure and recreation, this blindness is frequently seen in the perpetuation of Whiteness ideologies. It appears in the design and implementation of programs. It appears in the membership of organisations (Carter & Rose, 2024). Race is simply not discussed. Problems are attributed to individual failures or bad luck rather than systemic racism.

White estrangement describes campus environments where physical and social separation of white people further perpetuates other ideas of Whiteness. In Freire, the concept of divide and rule is the acceptance that oppressor ideologies allow adopters to be lifted out of oppression. But this happens only as individuals. And those individuals lose touch with their own characteristics of oppression. They become isolated from their communities. Leisure and recreation in outdoor spaces have a long history and association with Whiteness. Davis (2018) points out that policies such as

the Wilderness Act of 1964 marginalised African American communities. They privileged elite white ideas of nature and erased Black participation in outdoor spaces. Ideas about wilderness exploration, land use, conservation, and nature access all have their roots in white settler colonialist ideas (Carter & Rose, 2024; Ho & Chang, 2022).

Scholars have critiqued white approaches in leisure studies. Mowatt (2017) critiques the White approaches in leisure studies, which fail to account for the historical and ongoing impacts of colonialism and racism on access and participation. Mowatt (2017) calls for a critical expansion of leisure theory by centering racialized histories of land, recreation, and public space. Leisure studies often treat race as an afterthought. It assumes a universal subject position that erases Black and Indigenous experiences. This erasure is not accidental. It is a result of white estrangement, where people are separated from each other and from their histories.

Based on this analysis, we assert that the study and field of leisure and recreation are not exempt from these frameworks. It is part of the higher education landscape. It must therefore seek methods to address change within these four characteristics. We will now explore how Freire's concepts of dialogical action can be used to address these problematic pedagogies.

Applying Freire's Dialogical Actions to Leisure Studies

Freire offers specific approaches through dialogical actions to address systemic inequities. Dialogical actions promote active engagement among individuals. They enable people to understand different perspectives. They foster dialogue that co-creates knowledge and works toward shared goals. These actions ultimately lead to social change or personal transformation. Actions such as cooperation, praxis, and cultural synthesis provide pathways for transformative movements toward equity in leisure and recreation studies. Freire's philosophy presents significant implications for challenging dominant pedagogical practices that reinforce Whiteness, monoculturalism, and exclusion.

Many social science researchers have already highlighted ways to address these systemic inequities. Their work complements Freire's dialogical action theory. Scholars such as bell hooks (1994) and Henry Giroux (1997) have contributed to critical pedagogy in education. They advocate for teaching practices that empower marginalised students and challenge oppressive structures. In *Teaching to Transgress*, hooks (1994) emphasises the importance of engaged pedagogy. This approach centres critical thinking and values the experiences of students, particularly those from marginalised backgrounds. hooks (1994) argues that education should serve as a practice of freedom. It should encourage students to challenge societal norms and become agents of change. This understanding aligns closely with Freire's

belief in education as a tool for liberation. Dialogue and reflection enable students to critically engage with their lived realities. This is the concept of *conscientização*.

Giroux (1997) similarly emphasises the political nature of education. He advocates for teaching that actively addresses social justice issues. He critiques the notion of neutrality in education. Such neutral actions often reinforce existing power structures. Giroux's perspective echoes Freire's critique of the banking model of education. To address this banking model, Freire suggests adopting a dialogical method that emphasizes the co-creation of knowledge. This counteracts oppressive dynamics by centering the voices and experiences of marginalized groups. It ensures that education does not perpetuate racialized hierarchies.

Scholars like Anderson and colleagues (2021) also contribute essential insights. Educators must be critically reflective in practice. This applies even to well-intentioned aims of volunteerism or diversity initiatives. They must recognise leisure as a contested space. Anderson et al. (2021) critique what they call the White Saviour Industrial Complex. In this complex, service-oriented project, the emotional satisfaction or learning experiences of white students are often prioritised over genuine community empowerment. Without critical reflection on power, privilege, and positionality, such engagements can reinforce the very hierarchies they seek to dismantle. Their work calls for pedagogical practices that are dialogical, rooted in praxis, and attentive to race and power. This makes their work an essential addition to Freire's philosophy. Educators can facilitate discussions on how power operates in recreational settings. They can empower students to question and resist these dynamics. Embedding dialogical actions into pedagogical frameworks opens opportunities for educators to create inclusive spaces that promote critical consciousness and foster liberation.

Co-Creation as a Foundation for Justice

Freire emphasises that co-creation and problem-posing education can be tools for dialogical action. Co-creation and problem-posing open the possibility for critical engagement among oppressed communities. They also enable critical discourse on issues in leisure and recreation studies (Dustin et al., 2019). Co-creation is fostered through problem-posing, facilitated by the educator. But the educator is in service to the shared analysis and interrogation of experience. These practices can validate diverse perspectives. They can challenge hegemonic narratives of whiteness in educational settings (Rose & Paisley, 2012).

In the context of leisure studies, co-creation necessitates a rethinking of the educator-student relationship. This rethinking is not just symbolic. It requires concrete changes to how courses are designed and taught. Classes may start with a co-design phase in which students are encouraged to share their learning outcomes. This creates a

platform to practice critical engagement. Knee and Thomas Means (2018) argue that classes may begin with a co-design phase in which students are encouraged to share their learning outcomes. For example, instructors might begin the semester with a co-designed syllabus activity. Students collaboratively identify key social justice themes they want to explore. These might include access to green spaces, the history of exclusion in parks, or the impact of gentrification on recreation opportunities. Students then help shape assignments that allow them to critically engage with those themes. This could involve reflective writing, community-based projects, or research papers.

Another example could involve students co-creating evaluation rubrics for group work or presentations. This centres mutual respect, diverse perspectives, and shared responsibility. It embodies Freire's commitment to dialogical relationships and shared meaning-making. Students have a voice in how they are evaluated. They learn to think critically about what counts as good work. They also learn to negotiate and collaborate with their peers. This is not a simple process. It can be messy and challenging. But that is part of the point. Education should not be about comfort. It should be about growth.

Central to these examples is the idea that co-creation begins with educators considering how to incorporate student voice and choice into course design. This might mean flexible deadlines, multiple assignment options, or student-led discussions. It means trusting students to take responsibility for their own learning. It also means being transparent about power dynamics. Educators should acknowledge that they have authority in the classroom. But they can choose to share that authority. They can invite students to be partners in the learning process.

Co-creation also extends beyond the classroom. Students can co-create programs with community partners. They can work with local organisations to design inclusive recreation programs. This requires genuine collaboration, not just token involvement. Educators should facilitate these partnerships carefully. They should ensure that community voices are centred, not just student learning. They should also help students reflect on their own positionality. This is not just about learning skills. It is about becoming more thoughtful, aware, and ethical practitioners.

Building Collective Agency through Praxis

To counter the divide-and-rule practice, Freire describes the path of unity, grounded in praxis. Praxis is the process of reflection and action aimed at transforming oppressive structures. In leisure studies, unity can be achieved through collaborative projects that address systemic inequities within the field. This perhaps begins with the thematic investigation of the students and educators themselves. They need to better understand their positionality with respect to local communities and systems of

power and oppression. This process may be inherently emotional. Therefore, integrating the work of Schultz and colleagues (2022) on emotional pedagogies can be useful when unpacking positionality and privilege in the context of social justice in leisure education.

Students and educators can then purposefully engage with local communities to design programs that address issues. These might include economic access or historical exclusion from public spaces. For instance, a group project might involve students partnering with a local nonprofit to design inclusive recreation programs for historically excluded populations. As students research barriers to participation and listen to community narratives, they engage in reflection. This is a thematic investigation. They then apply what they learn through collaborative program design. This is action. The educator, meanwhile, participates as a co-learner. They guide but do not dictate. They help students navigate ethical questions, positionality, and impact. This collaborative and critical approach provides the opportunity to engage in praxis. Students identify systemic issues and take collective action to address them. This is far better than perpetuating structural inequities through isolation and spectatorship. Unfortunately, isolation and spectatorship have been institutionalised and practised by educators for too long (Theriault, 2023).

Caution should be taken when shifting from praxis to action and seeking to engage in community work. As Anderson and colleagues (2021) write, particularly for white students and educators, they must "be aware of the historical and structural barriers that have caused the problem they seek to address, their own membership in the hegemonic group that has built or benefited from those barriers, and the complexities associated with accepting recognition for their efforts" (p. 546). This awareness is crucial. Without it, well-intentioned projects can do more harm than good. They can reinforce the very systems they aim to dismantle.

With awareness of the larger implications of action, grounded in thematic investigation prior to praxis and action, collaboration and a critical approach make education a catalyst for collective liberation. This aligns with Freire's vision of education. It is not about individual advancement. It is about collective transformation. It is about building power together to change oppressive structures. This is hard work. It requires patience, humility, and persistence. But it is the only path to lasting change.

Decolonised Pedagogy through Cultural Synthesis

Cultural synthesis promotes the integration of diverse worldviews through dialogue and respect. Freire offers a framework for decolonising education through cultural synthesis. This treats different cultures equally and gives them equal authority. It is the opposite of cultural invasion, which imposes the oppressors' values onto the

oppressed. In leisure studies, dominant narratives often marginalise non-Western perspectives (Carter & Rose, 2024). For example, instead of teaching concepts of wilderness from white Eurocentric narratives, educators in leisure studies can integrate Indigenous knowledge systems. Kimmerer (2013) provides a holistic understanding of human-nature relationships by highlighting interconnections between land, culture, and identity.

A practical application might involve inviting Indigenous community members into the classroom. They can co-facilitate sessions on traditional ecological knowledge. Students can then engage in student-led reflections that connect these teachings to their own cultural assumptions about wilderness. This is not a one-time event. It should be an ongoing relationship built on trust and respect. Alternatively, an assignment might involve students comparing land-use ethics from multiple worldviews. This could go beyond the common preservationist-versus-conservationist dichotomy. Students might compare Western Leave No Trace principles with Indigenous relationality with the land. They could discuss the implications for their future practice. What does it mean to be a recreation professional who respects multiple ways of knowing? What does it mean to challenge dominant narratives in their own work?

Cultural synthesis is not about appropriating Indigenous knowledge. It is about respecting it as equally valid. It is about recognising that Western knowledge is not the only knowledge. It is about creating space for other voices to be heard. This requires humility and a willingness to learn. It also requires action. Educators should not just talk about decolonisation. They should change their curricula and teaching practices. They should seek out partnerships with Indigenous communities. They should support Indigenous scholars and practitioners. They should challenge institutional policies that maintain white supremacy.

Cultural synthesis also applies to other marginalised perspectives. Leisure educators should include voices from Black, Latinx, Asian, and other communities. They should teach about the histories of exclusion and resistance in leisure spaces. They should help students understand that leisure is not neutral. It is shaped by race, class, gender, and other systems of power. By doing this, educators help students become more critical and aware practitioners. They prepare students to work in diverse communities. They also prepare students to challenge injustice in their own fields.

Conclusion

Freire, in *Pedagogy of the Oppressed* (1970), outlines the systemic issues used by the oppressor to maintain control over the oppressed. To continue exploitation, the oppressor employs tactics that deceive the oppressed into believing in their own nobility. White Saviour is an example where, instead of addressing the root structural

cause, white people offer momentary consolation to keep control over marginalised people (Anderson et al., 2021). Freire offers dialogical actions such as cooperation, praxis, and cultural synthesis as practical tools. These counter oppressive practices and offer a practical approach to integrating theories into practices that can lead to social change and liberation.

Leisure educators should adopt Freire's framework as a theoretical foundation to guide transformative practices. They should move away from banking models of instruction. They should move toward co-created learning experiences that centre on students' lived experiences and community engagement. Educators should critically reflect on their positionality. They should intentionally cultivate dialogical classrooms where knowledge flows bidirectionally. Institutions should support pedagogy that challenges dominant ideologies, including Whiteness and monoculturalism. They should create space for multiple epistemologies to thrive. This means changing policies, hiring practices, and evaluation criteria. It means supporting faculty who do this work. It means valuing community engagement and social justice as much as traditional research.

By cultivating critical consciousness and embedding dialogical actions into their teaching, leisure educators can position education as a liberatory force. This commitment to reflection and co-created action enables educators and institutions to challenge oppressive structures. It creates an inclusive future aligned with Freire's vision of education as liberation. In doing so, educators affirm the humanity of their students and themselves. They help co-create a more inclusive and just future for the field. This is not easy work. It requires ongoing effort and learning. But it is essential for creating a field that truly serves all people. It is essential for building a world where everyone can experience the freedom and joy of leisure.

The path forward is clear. Educators must embrace Freire's vision. They must commit to dialogue, reflection, and action. They must challenge oppressive structures in their classrooms and beyond. They must centre the voices of marginalised communities. They must be willing to learn and change. This is the work of liberation. It is the work of love. And it is the work that leisure educators must undertake if they want to create a more just and inclusive world.

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CHAPTER FIFTEEN

Evaluation of Leaf Morpho-Anatomical and Fibre Quality and Characterisation of *Luffa Cylindrica* (L.) M. Roem. And *Luffa Acutangula* (L.) Roxb.

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Abstract

Luffa, a genus of tropical and subtropical vines in the cucumber family, shows morphological variation influenced by environmental factors. However, scientific data on the thermal and mechanical properties of *Luffa* fibres remain limited. This study investigated the leaf morpho-anatomical characteristics and fibre quality of *Luffa cylindrica* and *Luffa acutangula*, using mature fruits collected from eight local government areas in Kwara State, Nigeria. Seeds were cultivated in a randomised complete block design. Morphological analysis revealed greater variability in *L. cylindrica* for stem girth, leaf size, and qualitative traits. Anatomically, both species were amphistomatic, with *L. cylindrica* bearing trichomes on both surfaces, unlike *L. acutangula*. Mechanical testing showed that *L. cylindrica* had superior tensile strength, modulus, flexural strength, and hardness, whereas *L. acutangula* exhibited higher impact energy and elongation. These findings suggested *L. cylindrica* is better suited for industrial fiber applications, supporting the need for its cultivation and promotion for commercial use.

Keywords: Luffa cylindrica, Luffa acutangula, Fibre quality, Anatomy.

Introduction

Species of the genus *Luffa* belonging to the family Cucurbitaceae are widely cultivated in tropical and subtropical regions for food, fiber, and industrial purposes (Cheng *et al.,* 2020). They are significant vines known for their economic value majorly from their fruit, which upon maturation and drying, yields a fibrous network natural sponge like fiber (Barirega & Van Damme, 2014). It has also been reported to be used for various applications such as tissue for engine filters, steel helmet lining, insulation, packing materials and

filters in factories. In Nigeria, *Luffa cylindrica* (smooth loofah) and *Luffa acutangula* (ridged loofah) are the most commonly cultivated species. They are known for their adaptability and diverse uses, particularly as scrubbing sponges and reinforcement in composite materials (Wambua *et al*., 2003). Despite their uses, taxonomic delimitation, especially between *L. cylindrica* and *L. acutangula*, remains ambiguous due to their morphological similarities and interspecific hybridisation potential (Heiser & Schilling, 1990; Bal *et al*., 2004). The Luffa species are influenced by a complex interplay of genetic factors and environmental conditions (Widen & Sheinmann, 2006). Understanding this variation is important for germplasm classification and identification of superior genotypes for specific applications. In addition, the anatomical information of the leaves and stems can provide significant taxonomic insights.

As Nigeria explores bio-based resources due to interest in sustainable, renewable and biodegradable materials, this has increased the search for the potential of natural fibres to replace synthetic ones in various applications. Luffa fibres, a natural, readily available and relatively expensive fibers, have been looked into as a possible alternative (Mohanty *et al*., 2000). However, a comprehensive understanding of the morpho-anatomical and mechanical properties of Luffa species is critical for their optimal utilisation in bio-composites, textiles, and agro-industrial applications.

It is well documented that morphological traits have always been central to plant taxonomy (Zaman *et al*., 2025), but recently, leaf epidermal features and anatomical markers have been used to resolve ambiguities (Mbagwu & Edeoga, 2006). Luffa's fibrous vascular endocarp has attracted interest for use in industrial composites due to its biodegradability and high cellulose content (Tanobe *et al*., 2005). However, environmental conditions and genetic variability influence their mechanical properties (Siqueira *et al*., 2010). A comparative analysis of different species, particularly those cultivated in different geographical regions like Nigeria, remains limited and, therefore, necessitates region-specific characterisation studies of Luffa. The study aimed to address the gap by conducting a detailed investigation into the morpho–anatomical characteristics and fibre quality of Luffa cylindrica and Luffa acutangular accessions collected and cultivated in Kwara State, Nigeria.

Materials and Methods

Mature dry fruits of 20 accessions of *Luffa cylindrica* (18) and *Luffa acutangula* (2) were collected from eight (8), selected randomly from the sixteen (16) different local government areas with different provenances and settlements within Kwara State, Nigeria (Table 1). Voucher specimen were deposited, identified and authenticated at the herbarium, Department of Plant Biology, Faculty of Life Sciences, University of Ilorin. Seeds were extracted from the collected fruits and cultivated at the Botanical Garden of University of Ilorin using a randomised complete block design with three replicates per accession. Standard agronomic practices were followed to ensure optimal growth.

Morphological Characterisation: Morphological quantitative traits data including stem girth, leaf length and width were measured at seedling and maturity stages, using standard protocols (Radford *et al*., 1974). Qualitative traits including leaf colour, flower colour, fruit shape and seed characteristics were visually assessed and recorded, using descriptive terminology based on established description (Zalapa *et al*., 2006)

Anatomical Studies: Leaf peels sample from fully expanded mature leaves of all the *Luffa* accessions were prepared using nitric acid maceration. Epidermal peels obtained were stained with safranin. Stomatal density, length, width, size, index, and type and epidermal density and shapes were assessed with light microscopy (Khan *et al*., 2017).

Fiber Testing: Mature dry fruits of *Luffa* accessions were processed to extract the fibrous vascular network. The fruits were retted for several days to enhance removal of outer skin and pulp. Resulting fibrous sponges were then thoroughly washed, dried and cut into test specimen of uniform dimension. Mechanical tests (tensile strength, strain, flexural strength, hardness, elongation, impact energy) were conducted on retted and dried fruit fibers. Six (6) accessions of already retted and air-dried *Luffa* species were randomly selected, pulverised and analysed for percentage chemical composition

Table 1: *Luffa* Species Accession Code Numbers, Location of Acquisition and GPS Coordinates

Accesssion code No	Location	GPS Coordinates
01 OGD	Ogidi, IL-West	8.21' N, 4.26' E
02 UIL	Unilorin Garden, IL-South	9.54' N, 4.45' E
03 AGB	Agbooba Area, IL-West	8.43' N, 4.50' E
04 ADW	Adewole Estate, IL-West	8.51' N, 4.42' E
05 SHK	Sheik Abdulkadri College, IL-West	8.29' N, 4.46' E
06 APL	Apalara Area, IL-West	8.25' N, 4.39' E
07 OKF	Okefoma Area, IL-West	8.40' N, 4.42' E
08 ARP	Airport Road,IL-West	8.49' N, 4.59' E
09 ALG	Alagbado Hospital, IL-South	9.40' N, 5'00' E
10 OKL	Okelele Area, IL-East	10.28' N, 5.07' E
11 AGS	Agric Sango, IL-South	9.43' N, 4.20' E
12 KSU	Kwasu Malete, Moro	9.64' N, 4.99' E
13 OLJ	Oloje Estate, IL-West	8.39' N, 4.19' E
14 OKY	Okeoyi, IL-East	10.26' N, 5.04' E
15 OFG	Offa Garage, IL-South	9.86' N, 4.95' E
16 OKS	Oke Ose, IL-East	10.85' N, 4.69' E
17 OMP	Omupo, Ifelodun	9.04' N, 4.98' E
18 OFF	Offa COHT, Offa	9.92' N, 4.95' E
19 EIY	Eiyenkorin, Asa	9.45' N, 4.47' E
20 AJS	Ajasepo ipo, Irepodun	10.04' N, 4.80' E

Note: - 14 OKY and 15 OFG are *luffa acutangula* while other accessions are *luffa cylindrical*

Data Analysis

Data obtained from morphological measurements, anatomical studies and fibre testing were analysed, using ANOVA on SPSS version 25 to determine significant differences. Significant post hoc test using Duncan Multiple Range Test (DMRT) were also conducted to identify specific between the means.

Results

Morphological Variation

The morphological analysis revealed significant variations between *L. cylindrica* and *L. acutangula*. L. cylindrica exhibited a larger range of stem girth (5.39 to 7.52 cm), leaf length (11.10 – 16.50), leaf width (7.37 – 13.03) compared to L. acutangular with stem girth (4.20 -6.49), leaf length (9.95 – 10.60) and leaf width (7.33 – 9.33) (Tale 2). Statistical analysis indicated significant differences ($p < 0.05$) for these quantitative traits between the two species. Qualitatively, *L. cylindrica* displayed black, brown and oblong seeds while *L. acutangula* exhibited grayish black and ovate seeds (Table 3). L. cylindrica showed dark green leaves with bright yellow flowers and elongated cylindrical fruits, whereas L. acutangula had light green leaves with light yellow flowers and elongated spindle-shaped fruits. These qualitative traits provided distinguishing features between the two species.

Anatomical Features

Anatomical examination of foliar epidermis of both *Luffa* spp studied revealed that they were amphistomatic (i.e., possessing stomata on the upper and lower epidermal surfaces) with a predominance of Staurocytic stomata. Epidermal cells wall varied between polygonal and irregular shapes, often with polygonal forms on the adaxial surface and irregular patterns on the abaxial side (Table 4). *L. cylindrica* possess trichomes on both epidermal surfaces while *L. acutangula* lacked trichomes on the lower epidermal surfaces (Figure 1 and Table 5).

Table 2: Morphological Quantitative Features of the 20 Accessions of *Luffa* Species

ACC NO	STGTH(CM)	LFLGTH(CM)	LFWDT(CM)	SLFLGTH(CM)	SLFWDT (CM)
01OGD	5.99 ± 0.32^{abcd}	16.50 ± 0.67^{a}	$13 .03 \pm 0.39^{a}$	3.97 ± 0.12^{a}	2.00 ± 0.06^{a}
02UIL	5.74 ± 1.22^{abcd}	11.10 ± 0.60^{fgh}	7.37 ± 0.56^{ef}	3.87 ± 0.18^{a}	1.92 ± 0.06^{a}
03AGB	4.72 ± 0.97^{cd}	14.97 ± 0.41^{abcd}	10.40 ± 0.49^{bc}	3.97 ± 0.27^{a}	1.92 ± 0.04^{a}
04ADW	4.38 ± 0.68^{d}	16.50 ± 0.51^{a}	10.97 ± 0.41^{ab}	4.00 ± 0.44^{a}	1.97 ± 0.07^{a}
05SHK	4.86 ± 0.48^{bcd}	14.87 ± 1.29^{abcd}	10.20 ± 0.98^{bc}	4.20 ± 0.21^{a}	1.93 ± 0.13^{a}
06APL	4.30 ± 0.65^{d}	15.73 ± 0.46^{abc}	10.00 ± 0.26^{abc}	3.83 ± 0.12^{a}	1.98 ± 0.07^{a}
07OKF	4.22 ± 0.30^{d}	14.70 ± 1.08^{abcd}	8.63 ± 1.79^{bcdef}	3.93 ± 0.22^{a}	1.83 ± 0.03^{a}
08ARP	4.26 ± 0.29^{d}	16.40 ± 0.79^{ab}	10.93 ± 0.89^{ab}	3.77 ± 0.12^{a}	2.02 ± 0.09^{a}
09ALG	3.98 ± 0.50d	13.33 ± 1.22^{cdef}	6.40 ± 0.49^{f}	3.80 ± 0.36^{a}	2.05 ± 0.23^{a}
10OKL	5.52 ± 0.82^{abcd}	14.03 ± 0.98^{abcd}	9.30 ± 1.10^{bcde}	3.67 ± 0.28^{a}	1.97 ± 0.07^{a}
11SNG	5.39 ± 0.53^{abcd}	13.47 ± 0.62^{cdef}	8.20 ± 0.89^{cdef}	3.73 ± 0.19^{a}	1.97 ± 0.09^{a}
12KSU	7.52 ± 0.97^{a}	13.93 ± 1.41^{abcd}	9.30 ± 0.75^{bcde}	3.80 ± 0.06^{a}	1.93 ± 0.09^{a}
13OLJ	7.21 ± 1.37^{abc}	12.63 ± 1.33^{defg}	9.07 ± 0.45^{bcde}	4.10 ± 0.10^{a}	1.90 ± 0.06^{a}

14OKY	6.49 ± 0.47^{abcd}	10.60 ± 0.32^{gh}	9.33 ± 0.43^{bcde}	3.63 ± 0.09^{a}	2.00 ± 0.06^{a}
15OFG	4.20 ± 0.33^{d}	9.95 ± 0.09^{h}	7.33 ± 0.64^{ef}	3.80 ± 0.06^{a}	1.80 ± 0.06^{a}
16OKS	5.20 ± 1.45^{abcd}	11.20 ± 0.68^{efgh}	7.63 ± 0.48^{def}	3.67 ± 0.17^{a}	1.98 ± 0.12^{a}
17OMP	6.41 ± 0.34^{abcd}	13.13 ± 0.56^{cdef}	8.03 ± 0.74^{cdef}	3.87 ± 0.09^{a}	1.93 ± 0.09^{a}
180FF	5.77 ± 0.98^{abcd}	14.07 ± 0.73^{abcd}	10.20 ± 0.61^{bc}	3.67 ± 0.20^{a}	1.92 ± 0.09^{a}
19EIY	6.34 ± 0.54^{abcd}	13.87 ± 0.52^{abcde}	8.10 ± 0.26^{cdef}	3.70 ± 0.29^{a}	2.03 ± 0.03^{a}
20AJS	7.34 ± 0.23^{ab}	13.67 ± 0.72^{bcdef}	9.67 ± 0.49^{bcde}	4.03 ± 0.13^{a}	1.88 ± 0.06^{a}

Mean values ± Standard errors, Duncan's Multiple range rankings of Morphological features of the 20 *Luffa* species accessions. Different letters along columns depicts significant difference at $P<0.05$. Acc. Cod. No. = Accession Code Number, STGTH = Stem girth, LFLGHT = Matured Leaf Length, LFWDTH = Matured Leaf Width, SLFLGHT = Seedling Leaf Length, SLFWDTH = Seedling Leaf Width C.V= Coefficient of Variance. ± Standard error.

Table 3 Morphological Qualitative features of the 20 accessions of *Luffa* species

Acc. No.	Leaf colour	Flower colour	Fruit shape	Seed colour	Seed shape
01OGD	Dark green	Bright yellow	Elongated and cylindrical	Black and Brown	Oblong
02UIL	Dark green	Bright yellow	Elongated and cylindrical	Black and Brown	Oblong
03AGB	Dark green	Bright	Elongated and	Black and	Oblong

		yellow	cylindrical		Brown		
04ADW	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
05SHK	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
06APL	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
07OKF	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
08ARP	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
09ALG	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
10OKL	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
11SNG	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
12KSU	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
13OLJ	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
14OKY	Light green	Light yellow	Elongated and spindle		Greyish Black		Ovate
15OFG	Light green	Light yellow	Elongated and spindle		Greyish Black		Ovate
16OKS	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
17OMP	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
180FF	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
19EIY	Dark green	Bright	Elongated	and	Black	and	Oblong

		yellow	cylindrical		Brown	
20AJS	Dark green	Bright yellow	Elongated cylindrical	and	Black and Brown	Oblong

Table 4: Leaf Anatomical Features of the 20 Accessions of two *Luffa* Species

Acc. Cod. NO	Surface	STLT(mm^2)	STWT(mm^2)	STD	ECLT(mm^2)	ECWT(mm^2)
01OGD	U	10.20 ± 0.58^{abcdef}	9.00 ± 0.58^{a}	98.68 ± 6.58^{bcd}	17.60 ± 0.75^{abcde}	11.60 ± 1.21^{cd}
	L	9.40 ± 0.40^{cdefgh}	5.00 ± 0.40^{i}	44.74 ± 5.26^{ghijkl}	10.80 ± 0.49^{lmn}	11.80 ± 0.58^{cd}
02UIL	U	10.40 ± 0.51^{abcde}	6.20 ± 0.51^{fghi}	86.84 ± 3.22^{bcd}	18.20 ± 1.16^{abc}	10.20 ± 0.66^{cdeh}
	L	8.40 ± 0.75^{gh}	5.60 ± 0.75^{ghi}	22.37 ± 2.63^{l}	12.20 ± 1.20^{klmn}	8.20 ± 0.49^{ghi}
03AGB	U	8.60 ± 0.24^{gh}	5.00 ± 0.24^{i}	69.74 ± 2.63^{defghij}	19.60 ± 0.51^{ab}	11.80 ± 1.07^{cd}
	L	11.20 ± 0.58^{a}	5.60 ± 0.58^{ghi}	47.37 ± 6.3^{fghij}	14.80 ± 1.24^{defghijk}	11.20 ± 0.58^{ghi}
04ADW	U	10.20 ± 0.37^{abcdef}	7.00 ± 0.37^{efgh}	102.63 ± 7.67^{bcd}	14.40 ± 0.75^{efghijk}	12.80 ± 1.50^{bcd}
	L	8.20 ± 0.20^{hi}	5.20 ± 0.20^{i}	31.58 ± 2.46^{l}	13.40 ± 0.87^{ijklmn}	8.20 ± 0.37^{bc}
05SHK	U	11.20 ± 0.58^{a}	5.40 ± 0.58^{hi}	136.84 ± 5.26^{a}	20.40 ± 0.51^{a}	11.00 ± 0.45^{cdefg}
	L	8.40 ± 0.24^{gh}	12.20 ± 0.24^{a}	80.26 ± 6.71^{def}	15.80 ± 0.37^{cdefghij}	10.20 ± 0.20^{cdefgh}
06APL	U	9.60 ± 0.24^{bcdefgh}	6.60 ± 0.24^{efghi}	86.84 ± 3.22^{bcd}	18.20 ± 1.16^{abc}	10.20 ± 0.66^{cdefgh}

	L	8.20±0.49^{hi}	5.60±0.49^{ghi}	76.32±5.49^{defgh}	12.20±1.20^{klmn}	8.20±0.49^{ghi}
07OKF	U	10.80±0.37^{abc}	7.20±0.37^{cdefgh}	86.84±6.71^{bcd}	17.40±0.68^{abcdef}	12.80±1.66^{bc}
	L	8.60±0.40^{gh}	5.00±0.40^{i}	50.00±4.46^{efghijkl}	11.80±0.66^{klmn}	9.20±0.49^{defghi}
08ARP	U	10.60±0.40^{abcd}	7.80±0.40^{bcdef}	77.63±13.22^{defg}	18.00±1.67^{abcd}	11.20±1.24^{cdef}
	L	8.80±0.37^{fgh}	6.40±0.37^{efghi}	25.00±3.83^{l}	10.20±1.02^{n}	8.40±0.51^{fghi}
09ALG	U	10.20±0.20^{abcdef}	9.00±0.20^{b}	82.90±5.43^{cde}	18.00±1.05^{abcd}	11.80±0.86^{cd}
	L	9.20±0.20^{defgh}	7.00±0.20^{defgh}	22.37±1.61^{l}	10.60±1.12^{mn}	7.40±0.24^{i}
10OKL	U	10.20±0.20^{abcdef}	5.80±0.20^{ghi}	92.10±8.58^{abcd}	14.00±1.30^{ghijkl}	17.80±1.24^{a}
	L	8.60±0.40^{gh}	5.40±0.40^{hi}	28.95±1.61^{l}	4.40±0.24^{o}	14.60±1.60^{b}
11SNG	U	10.60±0.24^{abcd}	7.20±0.24^{cdefg}	119.74±6.38^{ab}	13.60±0.98^{hijklm}	8.80±0.49^{efghi}
	L	8.40±0.24^{gh}	6.20±0.24^{fghi}	30.26±3.35^{l}	14.20±1.74^{fghijk}	10.40±0.51^{cdefgh}
12KSU	U	11.20±0.37^{a}	8.00±0.37^{bcde}	100.00±9.16^{bcd}	17.80±0.73^{abcd}	10.40±1.69^{cdefgh}
	L	8.60±0.40^{gh}	5.40±0.40^{hi}	25.00±3.83^{l}	10.60±0.40^{mn}	8.80±0.58^{efghi}
13OLJ	U	11.00±0.45^{ab}	9.40±0.45^{b}	92.11±9.30^{bcd}	16.80±1.11^{bcdefgh}	11.20±0.37^{cdef}
	L	8.80±0.20^{fgh}	5.40±0.20^{hi}	42.10±5.34^{hijkl}	14.20±1.07^{fghijk}	8.40±0.51^{fghi}

14OKY	U	8.20±0.37^{hi}	5.40±0.37^{hi}	72.37±2.94^{defghi}	15.60±0.87^{cdefghij}	9.20±0.49^{defghi}
	L	7.00±0.45^{i}	6.40±0.45^{efghi}	34.21±4.83^{kl}	13.20±0.73^{jklmn}	10.80±0.37^{cdefgh}
15OFG	U	8.40±0.40^{gh}	7.20±0.40^{cdefg}	68.42±3.36^{defghijk}	14.00±0.71^{cdefghij}	9.00±0.45^{defghi}
	L	9.20±0.37^{defgh}	8.60±0.37^{bcd}	38.16±4.83^{ijkl}	13.80±0.80^{jklmn}	8.40±0.51^{fghi}
16OKS	U	9.60±0.24^{bcdefgh}	8.40±0.24^{bcd}	72.37±2.94^{defghi}	15.60±0.87^{bcdefghi}	9.20±0.49^{defghij}
	L	8.20±0.20^{hi}	5.00±0.20^{i}	34.21±4.83^{kl}	13.20±0.73^{jklmn}	10.80±0.37^{cdefgh}
17OMP	U	10.40±0.24^{abcde}	8.80±0.24^{bc}	98.68±11.39^{bcd}	16.60±1.63^{bcdefghi}	11.80±0.66^{cd}
	L	8.80±0.37^{fgh}	5.20±0.37^{i}	36.84±4.46^{jkl}	13.20±0.97^{jklmn}	8.60±0.60^{fghi}
180FF	U	10.40±0.40^{abcdef}	9.20±0.40^{b}	117.10±6.38^{abc}	17.20±1.20^{abcdef}	11.40±0.75^{cde}
	L	9.00±0.32^{efgh}	5.40±0.32^{hi}	31.58±2.46^{l}	12.60±0.75^{jklmn}	8.40±0.40^{fghi}
19EIY	U	9.60±0.24^{bcdefgh}	9.40±0.24^{b}	115.79±7.95^{abc}	17.40±0.51^{abcd}	11.40±0.51^{cde}
	L	8.80±0.37^{fgh}	6.20±0.37^{fghi}	31.58±2.46^{l}	13.20±0.97^{jklmn}	8.00±0.32^{hi}
20AJS	U	9.80±0.58^{abcdefg}	9.40±0.58^{b}	98.69±9.76^{bcd}	18.00±0.55^{abcd}	11.80±1.11^{cd}
	L	8.40±1.03^{gh}	7.20±1.03^{cdefg}	34.21±3.83^{kl}	12.80±0.80^{jklmn}	8.40±0.68^{fghi}

Mean values, standard error and different letters along columns depicting significant difference at 0.05 level using ANOVA test. Acc. Cod. No. = Accession Code Number, STLT = Stomata length, STWT = Stomatal width,

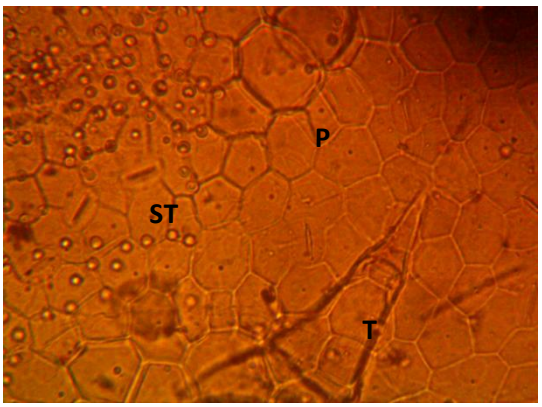
STD= Stomatal Density, ECWT = Epidermal cell width, ECLT = Epidermal cell length, U = Upper leaf surface, L = Lower leaf surface.

Table 5: Leaf Anatomical Features of the 20 accessions of two Luffa Species

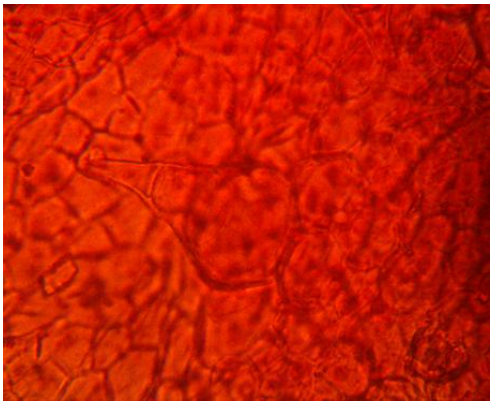
Acc. Cod. No	Surface	ECD	STSZ(μm ^{2})	STID(%)	ECS	Trichomes
01OGD	U	426.31±10.69^{cde}	72.09±4.69^{ab}	18.83±1.31^{abcde}	Polygonal	Present
	L	572.37±5.89^{a}	36.91±2.94^{ijklm}	7.24±0.84^{jkl}	Polygonal	Present
02UIL	U	436.84±11.32^{bcde}	51.35±6.89^{defghi}	16.63±0.8^{bcdefg}	Polygonal	Present
	L	552.63±25.05^{a}	36.75±3.28^{ijklm}	3.90±0.47^{j}	Irregular	Present
03AGB	U	438.16±29.17^{bcde}	33.92±2.82^{lm}	13.87±0.79^{fghi}	Polygonal	Present
	L	576.32±10.32^{a}	49.31±3.60^{efghijk}	7.56±0.95^{jkl}	Irregular	Present
04ADW	U	482.89±17.85^{bcd}	56.54±7.23^{cdefgh}	17.45±0.81^{abcdefg}	Polygonal	Present
	L	584.21±5.66^{a}	33.61±2.96^{lm}	5.12±0.37^{kl}	Irregular	Present
05SHK	U	547.37±13.71^{a}	47.74±4.14^{fghijkl}	20.02±0.79^{abc}	Polygonal	Present
	L	601.32±13.26^{a}	80.41±6.64^{a}	11.70±0.65^{hij}	Irregular	Present
06APL	U	436.84±11.32^{bcde}	50.26±6.26^{efghij}	16.63±0.80^{bcdefg}	Polygonal	Present
	L	568.42±21.48^{a}	35.81±1.52^{jklm}	9.99±6.38^{ijk}	Irregular	Present
07OKF	U	485.53±7.02^{bc}	61.72±7.80^{bcdef}	15.15±1.06^{defgh}	Polygonal	Present
	L	567.11±13.39^{a}	33.61±3.50^{lm}	8.11±0.70^{jkl}	Polygonal	Present
08ARP	U	460.53±8.58^{bcd}	64.70±5.33^{bcd}	14.30±2.25^{efghi}	Polygonal	Present
	L	561.84±19.25^{a}	44.45±5.61^{hijklm}	4.25±0.60^{l}	Polygonal	Present
09ALG	U	440.79±12.82^{bcde}	72.24±4.58^{ab}	15.82±0.87^{cdefgh}	Polygonal	Present
	L	569.74±11.51^{a}	50.57±4.02^{defghij}	3.78±0.27^{l}	Irregular	Present
10OKL	U	432.89±20.00^{bcde}	46.64±3.88^{ghijklm}	17.61±1.69^{abcdefg}	Polygonal	Present
	L	564.48±12.02^{a}	36.28±1.37^{klm}	4.89±0.32^{l}	Irregular	Present
11SNG	U	436.84±31.52^{bcde}	60.15±4.23^{abcdefg}	21.63±0.93^{a}	Polygonal	Present

	L	543.42±28.80^{a}	40.83±1.31^{ijklm}	5.33±0.67^{kl}	Polygonal	Present
12KSU	U	463.16±25.45^{bcd}	70.51±4.42^{abc}	17.90±1.78^{abcdef}	Polygonal	Present
	L	565.79±10.81^{a}	36.59±2.89^{ijklm}	4.24±0.65^{l}	Irregular	Present
13OLJ	U	384.21±20.13^{e}	81.67±6.38^{a}	19.48±2.29^{abcd}	Polygonal	Present
	L	553.95±11.09^{a}	37.54±5.61^{ijklm}	6.99±0.72^{kl}	Polygonal	Present
14OKY	U	436.84±14.80^{bcde}	34.39±2.66lm	14.21±0.30^{efghi}	Polygonal	Absent
	L	560.53±7.62a	34.24±3.52^{klm}	5.76±0.84^{kl}	Polygonal	Present
15OFG	U	465.79±27.55^{bcd}	47.43±3.17^{fghijkl}	12.95±0.96^{ghi}	Polygonal	Absent
	L	486.84±30.65^{b}	62.19±3.31^{bcde}	7.26±0.73^{jkl}	Irregular	Present
16OKS	U	436.84±14.80^{bcde}	63.45±3.16^{bcde}	14.21±0.30^{efghi}	Polygonal	Present
	L	560.53±7.62^{a}	32.04±1.54^{m}	5.76±0.84^{kl}	Irregular	Present
17OMP	U	436.84±28.27^{de}	71.93±3.72^{ab}	18.55±2.15^{abcdef}	Polygonal	Present
	L	565.79±12.48^{a}	35.96±3.22^{jklm}	6.10±0.67^{kl}	Irregular	Present
180FF	U	425.00±10.73^{bcde}	74.60±3.35^{ab}	21.62±1.16^{a}	Polygonal	Present
	L	567.11±9.63^{a}	38.01±1.33^{ijklm}	5.27±0.38^{kl}	Polygonal	Present
19EIY	U	438.16±20.87^{bcde}	70.83±3.43^{ab}	20.91±1.61^{ab}	Polygonal	Present
	L	563.16±10.73^{a}	43.35±5.72^{hijklm}	5.32±0.43^{kl}	Irregular	Present
20AJS	U	423.68±10.11^{de}	71.61±2.82^{ab}	18.79±1.51^{abcde}	Polygonal	Present
	L	569.74±12.76^{a}	46.96±5.74^{ghijklm}	5.71±0.72^{kl}	Polygonal	Present

Mean values, standard error and different letters along columns depicting significant difference at 0.05 level using ANOVA test. Acc. Cod. No. = Accession Code Number, ECD = Epidermal cell density, STSZ = Stomatal size, STID = Stomatal index, ECS = Epidermal cell shape, U = Upper leaf surface, L = Lower leaf surface.

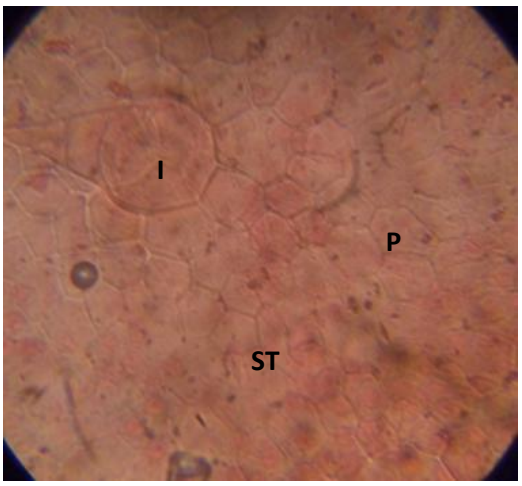


A



B

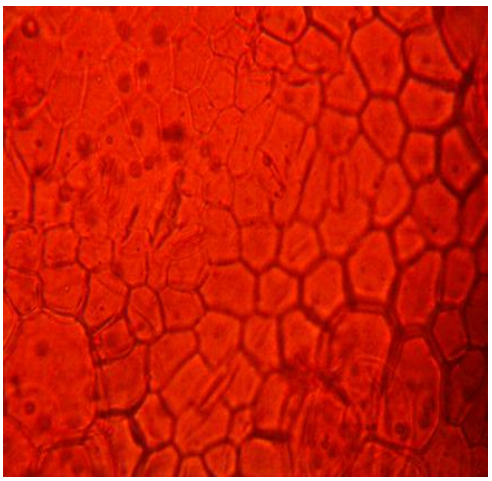
Plate 1:Photomicrographs of the *Luffa cylindrica* (A: Abaxial surface with l; B: Adaxial surface. ST: Staurocytic stomata; T: Trichome; P: Polygonal epidermal cell; I: Irregular epidermal cell)



A

ST

I



B

Plate 2:Photomicrographs of the *Luffa acutangula* (A: Abaxial surface with l; B: Adaxial surface. ST: Staurocytic stomata; T: Trichome; P: Polygonal epidermal cell; I: Irregular epidermal cell)

Fiber Mechanical Properties

The mechanical analysis of fiber revealed a significant difference ($p < 0.05$) in the mechanical properties of the fibers of the two *Luffa* species. Tensile stress ranged from 13.66 to 17.82 N/mm^2, tensile strain ranged from 0.05 to 0.09, percentage elongation ranges from 4.49% tom9.06%, tensile modulus ranged from 187.08 to 397.26 N/mm^2 (Table 6), flexural strength ranged from 45.65 to 8.82 N/mm^2, Impact energy ranged from 0.76 to 1.29J while hardness ranged from 91.01 to 96.71Hv (Table 7). *Luffa cylindrica* accessions demonstrates superior mechanical properties, particularly in tensile strength

(15–19 N/mm²), modulus, flexural strength (35–58 N/mm²), and hardness (up to 58 Hv), making it more suitable for applications requiring rigidity and strength. However, *Luffa acutangula*'s higher impact energy and elongation suggest it may be preferable for applications where flexibility and impact resistance are desired

Table 6: Mechanical Properties of Fires of the 20 Accessions of Luffa Species

Acc. No.	TStr (N/mm^2)	T Strain	% Elong	T Mod (N/mm^2)
01OGD	17.72±0.05^{a}	0.06 ±0.00^{cde}	6.64 ±0.17^{ef}	279.56±0.69^{e}
02UIL	17.82±0.09^{a}	0.08 ±0.01^{ab}	7.63 ±0.10^{c}	238.36±1.32^{ij}
03AGB	17.51±0.24^{a}	0.09 ±0.00^{a}	9.06 ±0.07^{a}	187.08±1.08^{p}
04ADW	17.70±0.09^{a}	0.07 ±0.00^{abcd}	6.97 ±0.17^{def}	261.52±0.62^{g}
05SHK	13.66±0.31f	0.06 ±0.00^{e}	4.49 ±0.27^{j}	307.26±3.16^{b}
06APL	14.36±0.29^{e}	0.05 ±0.00^{e}	4.89 ±0.02^{ij}	287.05±0.04^{c}
07OKF	16.85±0.11^{c}	0.06 ±0.00^{cde}	5.99 ±0.03^{gh}	282.40±0.73^{d}
08ARP	17.53±0.17^{a}	0.09 ±0.00^{a}	8.46 ±0.13^{b}	206.44±0.26^{n}
09ALG	14.73±0.12^{e}	0.07 ±0.00^{abcd}	7.23 ±0.21^{cd}	210.16±0.17^{m}
10OKL	14.66±0.16^{e}	0.07 ±0.00^{abcd}	6.28 ±0.14^{fg}	240.91±0.29^{i}
11SNG	16.61±0.19^{c}	0.07 ±0.00^{abcd}	6.60 ±0.28^{ef}	237.26±0.11^{j}
12KSU	14.67±0.15^{e}	0.07 ±0.01^{bcd}	5.68 ±0.14^{h}	273.81±0.37^{f}
13OLJ	15.31±0.16^{d}	0.07 ±0.01^{bcd}	5.93 ±0.04^{gh}	251.03±0.56^{h}
14OKY	13.66±0.17^{f}	0.07 ±0.00^{abcd}	6.68 ±0.13^{ef}	207.25±0.16^{n}
15OFG	14.68±0.20^{e}	0.08 ±0.00^{ab}	7.61 ±0.21^{c}	195.14±0.08^{o}
16OKS	16.63±0.06^{c}	0.07 ±0.00^{abcd}	6.80 ±0.08^{def}	239.22±0.20^{ij}
17OMP	17.42±0.24^{ab}	0.08 ±0.00^{abc}	8.31 ±0.18^{b}	212.45±0.28^{lm}
180FF	16.92±0.05^{bc}	0.06 ±0.01^{de}	5.10 ±0.34^{i}	338.03±0.74a
19EIY	16.50±0.18^{c}	0.08 ±0.00^{abc}	7.68 ±0.09^{c}	223.73±0.28^{k}
20AJS	12.69±0.34^{g}	0.06 ±0.00^{cde}	5.68 ±0.03^{h}	213.55±0.29^{l}

Table 7: Mechanical properties of fibres of the 20 accessions of *Luffa* species

Acc. No.	FL Strt (N/mm^2)	Impact (J)	Hardness (Hv)
01OGD	58.81 ±0.42^{a}	0.92±0.04^{hi}	96.44 ±0.51^{ab}
02UIL	57.48 ±0.48^{b}	0.78±0.01^{k}	93.70 ±0.12^{efgh}
03AGB	56.03 ±0.03^{cd}	0.87±0.01^{ij}	94.19 ±0.10^{defg}
04ADW	49.37 ±0.27^{h}	0.95±0.02^{gh}	94.67 ±2.34^{bcdef}
05SHK	49.47 ±0.25^{h}	1.06±0.02^{de}	96.06 ±0.02^{abc}
06APL	54.75 ±0.22^{fg}	1.08±0.01^{cde}	92.05 ±0.02^{hi}
07OKF	55.88±0.14^{cde}	0.88±0.02^{ij}	91.01 ±0.02^{i}
08ARP	58.42 ±0.24^{a}	0.79±0.00^{k}	94.91 ±0.12^{abcdef}
09ALG	57.47 ±0.04^{b}	0.84±0.01^{j}	96.01 ±0.01^{abc}
10OKL	56.54 ±0.26^{c}	0.91±0.00^{hi}	96.01 ±0.01^{abc}
11SNG	56.20 ±0.19^{c}	0.76±0.00^{k}	96.05 ±0.05^{abc}
12KSU	54.80 ±0.13^{fg}	0.98±0.00^{fg}	95.70 ±0.13^{abcd}
13OLJ	55.37 ±0.37^{def}	0.89±0.00^{ij}	94.43 ±0.06^{cdef}
14OKY	49.48 ±0.25^{h}	1.29±0.01^{a}	91.45 ±0.12^{i}
15OFG	45.65 ±0.21^{i}	1.13±0.04^{bc}	93.17 ±0.06^{fgh}
16OKS	55.30±0.18^{defg}	0.96±0.02^{gh}	95.14 ±0.06^{abcde}
17OMP	55.13 ±0.06^{efg}	1.07±0.01^{de}	95.15 ±0.05^{abcde}
180FF	56.56 ±0.08^{c}	1.17±0.01^{b}	96.71 ±0.10^{a}
19EIY	56.55 ±0.29^{c}	1.10±0.01^{cd}	94.57 ±0.08^{cdef}
20AJS	54.58 ±0.12^{g}	1.03±0.01^{ef}	92.56 ±0.05^{ghi}

Mean values, standard error and different letters columns depicting significant difference at P< 0.05 level using ANOVA test.Acc. No. = Accession Code Number, TStre = Tensile stress, Tstrain = Tensile strain, %Elong = Percentage elongation, Tmod = Tensile Modulus, Fl strt = Flexural Strength, Impact = Impact energy (strength), Hardness = Hardness, ± Standard error.

Discussion

The study provided analysis of the morpho-anatomical characteristics and fiber quality of *L. cylindrica* and *L. acutangula*. Results observed variation in stem girth, leaf length and leaf width showing the inherent variability with the genus *Luffa*. This is influenced potentially by genetic and environmental variability and adaptation within the study region (Zalapa *et al*., 2006). The distinct variability in qualitative traits supported the established taxonomic differentiation between the two species (Manikandaselvi *et al*., 2016). Anatomical findings showed that Luffa species are amphistomatic, a common feature in dicotyledonous plant which facilitates gaseous exchange (Khan *et al*. 2017). Differential distribution of trichomes present in both upper and lower epidermal surface of *L. cylindrica* and absent in the lower epidermal layer of *L. acutangula* could have implications for transpiration regulation and defense against herbivory (Viera *et al*., 2019). Morphological and anatomical traits confirmed that *L. cylindrica* possesses a broader range of adaptive features and fibre quality. The presence of trichomes on both surfaces and higher stomatal index suggested better adaptation to environmental conditions.

The significantly higher tensile strength observed in *L. cylindrica* suggests greater suitability for structural and reinforcement applications. This finding corroborates earlier reports by Boynard and D'Almeida (1999) and Tanobe et al. (2005), who reported favourable mechanical properties in *Luffa cylindrica* fibres.. Tensile strength is a crucial significant mechanical character that determines the suitability of fibers for reinforcement in composite materials and other structural application (Yan *et al*., 2012; Kumar *et al*., 2015). These findings further supported previous report of favourable mechanical properties of L. cylindrica fibres (Zampheri *et al*. 2016). The difference in fiber strength could be attributed to differences in the chemical composition such as cellulose content, microfibrillar angle and structural arrangements of fibers in the two species (Mohanty *et al*., 2000). The mechanical and chemical superiority of its fibers aligns with previous reports (Boynard & D'Almeida, 1999; Tanobe *et al*., 2005) while *L. acutangula* is useful, its softer, more elastic fibres are less suitable for load-bearing composites.

Conclusion

This study provided a comprehensive evaluation of the morphological, anatomical, and fibre-quality characteristics of Luffa cylindrica and Luffa acutangula accessions cultivated in Kwara State, Nigeria. Significant interspecific differences were observed in morphological traits, epidermal features, and mechanical properties of the fibres. Luffa cylindrica exhibited superior vegetative growth, greater tensile strength, higher tensile modulus, improved flexural strength, and greater hardness than L. acutangula. These characteristics indicated its greater potential for industrial applications, particularly in the production of bio-composites and other environmentally sustainable materials.

The anatomical features identified, including stomatal characteristics and trichome distribution, provided useful taxonomic markers for distinguishing the two species. The study, therefore, contributed valuable information for taxonomy, breeding programmes, conservation efforts, and industrial utilisation of Luffa species in Nigeria.

Future studies should integrate molecular characterisation techniques with morphological and anatomical data to strengthen species delimitation. Further investigations on fibre chemistry, durability, and large-scale industrial applications are also recommended.

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CHAPTER SIXTEEN

Global Antimicrobial Resistance Surveillance: Advocating for a sustainable future

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Abstract

Antimicrobial resistance (AMR) causes treatment failures, prolonged sickness, and higher mortality. The integration of a "One Health Approach" in the human, animal, and environmental health sectors through multisectoral collaboration is vital for AMR surveillance. This review highlighted the current AMR surveillance efforts. Tracking the trends of resistant infections across populations and regions is made easier by advocating sustainable educational initiatives of AMR surveillance. Some ongoing surveillance efforts include "the World AMR Awareness Week (WAAW), the Global Antimicrobial Resistance and Use Surveillance System (GLASS), the ResistanceMap, and the UK's Fleming Fund". The WHO's GLASS offers a unified framework for countries to track the progress of existing and emerging national surveillance systems.

Keywords: Global Antimicrobial, Resistance Surveillance, Sustainable, Future

Introduction

Tenmillion deaths worldwide would result from antibiotic resistance by 2050 if the current trend of inappropriate and excessive antibiotic use continues (Pulingam *et al.,* 2022). Antimicrobial resistance, a notable health concern that occurs when microbes (bacteria, viruses, fungi, and parasites) evolve mechanisms that protect them from the effects of antimicrobials (including antibiotics, antifungals, antivirals, and antiparasitics), enabling them to thrive (Ahmed *et al.,* 2024). These resistant microorganisms can spread and infect people, plants, and animals. "The overuse and abuse of antibiotics in various industries have led to the evolution of resistant bacteria, which is a primary

cause of antimicrobial resistance (AMR), a serious global health concern" (Ahmed *et al.,* 2024).

Surveillance of antimicrobial resistance is a fundamental action to inform efforts to handle the spread of AMR through the generation of evidence for local, national, and global guidance and action plans (Lim *et al*., 2021). "AMR surveillance involves the collection, validation, interpretation, and reporting of susceptibility data" (Lim *et al*., 2021).

The introduction of the "One Health Approach" calls for a worldwide cooperative effort involving several disciplines, including the "World Organisation of Animal Health (WOAH, formally OIE) and the Food and Agriculture Organisation of the United Nations (FAO), to guarantee that each agency operates within its area of expertise and with other agencies to minimise the possible effects of AMR" (Tang *et al*., 2023).

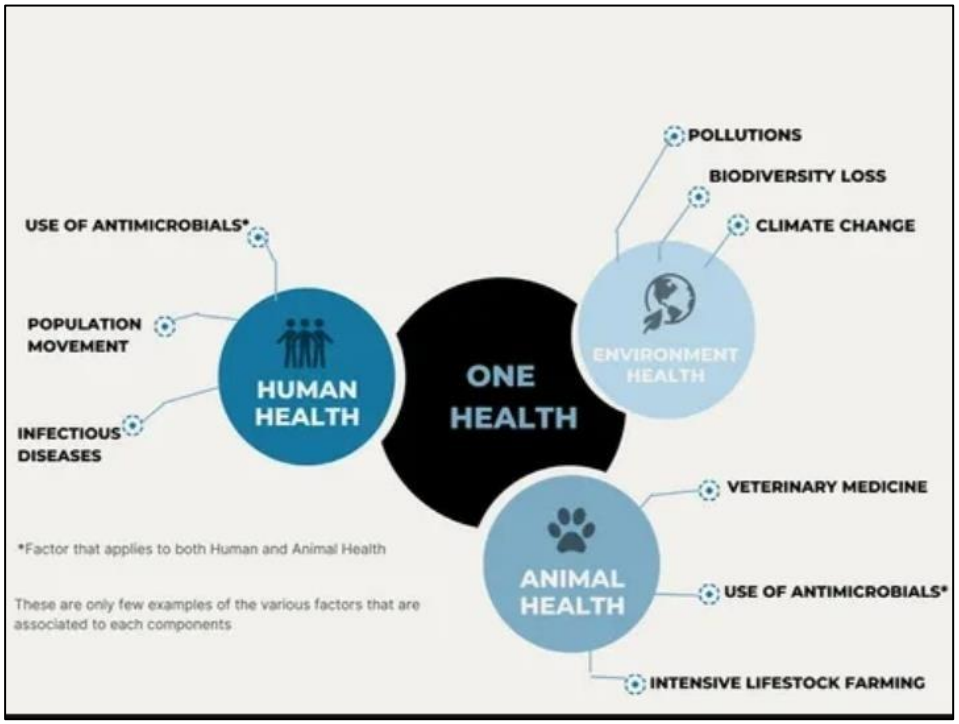


Figure 1: The concept of the One Health Approach (Tang *et al*., 2023)

Current AMR Surveillance Efforts

In 2015, the World Health Organisation (WHO) introduced the Global Action Plan on Antimicrobial Resistance (GAP AMR) to combat the growing global danger of antimicrobial resistance (AMR) (Khouja *et al*., 2022)

- Improve awareness and understanding (WHO, 2020).
- Strengthen knowledge through surveillance & research (WHO, 2020).
- Reduce the incidence of infection (WHO, 2020).
- Optimize the use of antimicrobial medicines (WHO, 2020).
- Ensure sustainable investment (WHO, 2020).

World AMR Awareness Week (WAAW)

The World AMR Awareness Week (WAAW), formerly called the World Antimicrobial Awareness Week, is celebrated from the 18th to the 24th of November every year to improve awareness and understanding of antimicrobial resistance (Sharma *et al*., 2024). In the year 2024, the World Antimicrobial Awareness Week was themed “Educate. Advocate. Act now.”

The theme aimed to raise awareness and understanding of antimicrobial resistance (AMR) and promote best practices among "One Health" stakeholders to reduce the emergence and spread of drug-resistant infections (Sharma *et al*., 2024).

The Global Antimicrobial Resistance and Use Surveillance System (GLASS)

The World Health Organisation (WHO) launched the Global Antimicrobial Resistance and Use Surveillance System (GLASS) after creating the Global Action Plan for managing AMR (GAP-AMR) to continuously fill in the knowledge gaps and accomplish the objectives "strengthen knowledge through surveillance and research" of the GAP-AMR program (WHO, 2021). On the 22nd of October 2015, the World Health Organisation (WHO) launched the Global Antimicrobial Resistance and Use Surveillance System (GLASS) to standardise the surveillance of antimicrobial resistance (AMR) (WHO, 2020). GLASS offers a standardised method for data collection, analysis, interpretation, and exchange among nations (WHO, 2020).

The various types of AMR-related surveillance activities led by GLASS are

grouped into a series of technical modules (WHO, 2020). These modules comprise surveillance activities built on routinely available data (for example, patient samples collected for clinical purposes or national sales of antimicrobials) and focused activities targeted at generating information for specific purposes, based on the needs of countries and regions (WHO, 2020). GLASS is also engaged in the design and implementation of surveys and studies aimed at helping countries to achieve a better quality and representativeness of their data (WHO, 2020). Furthermore, GLASS provides support, including evidence-based guidelines and technical documents, to assist countries and regions in building capacity and take appropriate and timely corrective actions (WHO, 2020).

The GLASS IT platform (https://extranet.who.int/glass/portal/), launched by the World Health Organization (WHO) in 2016, was designed for global data on antimicrobial resistance (AMR), Antimicrobial consumption (AMC), and Antimicrobial use (AMU), and also functions as a central platform for data sharing (WHO, 2020). Most of the IT components of GLASS's technical modules are hosted on this platform. Since its initial release, new analysis and export features have been added, improving its capabilities. Countries, territories, and regions can generate and export reports with graphical data representations and verify their accuracy using multiple metrics through data visualization (WHO, 2020). The user interface has been redesigned to offer a more straightforward, user-friendly, and intuitive experience (WHO, 2020).

ResistanceMap

In 2010, the ResistanceMap was created to help guide policies tackling antimicrobial resistance (AMR) by the Centre for Disease Dynamics, Economics & Policy (now One Health Trust) (Kapoor, 2021). It is an interactive global network that monitors changes in antibiotic use and resistance, offering vital information for public health initiatives (Kapoor, 2021). Antimicrobial resistance (AMR) and antibiotic use patterns in nations worldwide, including some "low- and middle-income countries (LMICs)", can be interactively explored with ResistanceMap (a web-based set of data visualization tools) (Kapoor, 2021).

UK's Fleming Fund

The Fleming Fund, supported by the UK Department of Health through its UK Aid, overseas development assistance programme, is one of the most

important multinational efforts aimed at enhancing AMR and AMC surveillance in "low- and middle-income countries (LMICs)" (Frost *et al*., 2021). The Fund takes a One Health approach and promotes surveillance activities at institutional, national, and regional levels through a £265 million investment (Frost *et al*., 2021). The Fleming Fund's initiatives complement and support existing AMR strategies, including national action plans, antimicrobial stewardship programmes, the development of empirical treatment guidelines, and regional frameworks such as the African Union's AMR control framework (Frost *et al*., 2021). Through various national and regional grants and programmes, the UK's Fleming Fund intends to establish sustainable AMR surveillance systems in over 30 countries across both Asia and Africa, while also encouraging cooperation among governments, the private sector, NGOs, academia, and the pharmaceutical and research communities (Frost *et al*., 2021).

Challenges Faced by Antimicrobial Resistance Surveillance Systems in the World

Data gathering and aggregation are extremely difficult tasks since information systems are frequently paper-based (Frost *et al*., 2021).

The funding of AMR control activities is "sector-specific" and mainly focused on human health. AMR control initiatives in non-human health domains are either "underfunded or undeveloped" in several LMICs (Frost *et al*., 2021).

The challenges are severe in low-income environments due to inadequate communications and laboratory infrastructures, limited resources, a shortage of skilled and qualified personnel, and a variety of behavioural and socioeconomic factors that contribute to resistance (Iskandar *et al*., 2021). "The quality and dependability of pathogen identification and antimicrobial susceptibility testing might be impacted by inadequate laboratory infrastructure" (Iskandar *et al*., 2021).

The underestimated impact of AMR is due to the weak connections between the environmental, animal, and human health sectors. This could be the result of conflicting political and economic objectives (Frost *et al*., 2021).

Due to inadequate continent-wide AMR surveillance data, gaining a complete understanding of the extent and impact of antimicrobial resistance (AMR) in

Africa remains a significant challenge. Although country data are available, they are not regularly gathered, disseminated, or acknowledged by national bodies, which restricts their ability to impact national policies (Okolie *et al*., 2023).

Strategies for Sustainable Antimicrobial Resistance Surveillance Systems

A key factor in determining the long-term success of AMR monitoring systems is ensuring financial sustainability. Finding outside finance through trusts and other funds has been the main strategy used in the literature to get beyond financial obstacles (Do *et al*., 2023).

Legal underpinnings (legal principles, laws, and precedents) for surveillance must be investigated to enhance surveillance systems and promote stakeholder cooperation where obstacles might exist (Do *et al*., 2023).

Accelerated implementation of one health national action plans must be at the heart of the global response to antimicrobial resistance (WHO, 2020). The establishment of good monitoring systems necessitates strong political will, capacity building, standardisation of procedures, tight coordination between all stakeholders, and a One Health approach (Frost *et al*., 2021).

Conclusion

Antimicrobial resistance causes treatment failures, longer sickness, and higher death, making it one of the WHO's top 10 worldwide public health challenges. It has a substantial financial impact on economies and healthcare systems. An integrated strategy is essential to address the escalating issue of antimicrobial resistance (AMR). This involves optimising antibiotic usage in healthcare environments, enhancing infection prevention and control measures, fostering innovation in antimicrobial drug discovery through dedicated research efforts, and educating both healthcare providers and the public on the critical importance of responsible antimicrobial stewardship. Working together to address this global problem can effectively slow the spread of antimicrobial resistance and maintain the effectiveness of the antimicrobial chemotherapies currently in use. Global cooperation, more funding, and ongoing political commitment are needed to combat AMR. In the battle against AMR, surveillance is essential since it allows for progress tracking and focused treatments.

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CHAPTER SEVENTEEN

Access to and Utilisation of Agricultural Extension Services Among Small-Scale Farmers in Asa Local Government Area, Kwara State, Nigeria: Challenges and Policy Implications

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Abstract

Small-scale farmers in Nigeria rely on agriculture for their livelihoods but face significant barriers in accessing effective extension services. This study examined these challenges using a mixed-methods approach involving qualitative and quantitative tools. Findings revealed that while extension services exist, they are underutilised. Radio, farmer cooperatives, and local networks were the primary information sources. Core services included advisory support and market information, while training programmes and workshops were least accessed. Key benefits noted were improved market access, productivity, and knowledge transfer. However, challenges such as inadequate funding, limited training, poor infrastructure, and restricted access to technology hindered effective utilisation. The study recommended increased funding, tailored training, infrastructural improvements, and stronger cooperatives. These strategies are essential for empowering small-scale farmers and promoting sustainable agricultural development in Nigeria.

Keywords: Agricultural Extension, Information Access, Small-scale farmers, Capacity building.

Introduction

The agricultural landscape of Nigeria is not only reliant on fertile soils but also shaped by a diverse community of farmers with varying needs and challenges (Ojo & Aliyu, 2022). Small-scale agriculture is vital for food security, employment, and the economic stability of the country (Adamu et al., 2021). It contributes to rural development, generates income, and plays a central role in household sustenance. Additionally, sustainable practices in

smallholder farming build resilience to climate variability and preserve cultural heritage (Adejuwon, 2020).

Despite its importance, small-scale farming is characterised by inadequate infrastructure, limited access to modern technology, and insufficient knowledge dissemination. These factors hinder productivity and competitiveness. Agricultural extension services are critical for bridging this gap, offering farmers relevant information, training, and technical support (Brown, 2021).

Given Nigeria's vast geographical and cultural diversity, a one-size-fits-all approach to extension service delivery is ineffective. Tailored services that reflect local realities and resource limitations are essential. Farmers face multiple barriers including poor road networks, limited funding, and constrained access to up-to-date agricultural practices (Johnson & Williams, 2019). In the era of digital agriculture and climate change, timely and inclusive extension services are more important than ever.

Agricultural extension acts as a bridge between innovation and practice, enabling the diffusion of sustainable techniques, access to markets, and adaptation to environmental change. However, the effectiveness of these services in Nigeria is often compromised by systemic issues such as underfunding, weak institutional support, and the absence of farmer-centred programming (Smith & Johnson, 2020).

This study explored these dynamics in Asa Local Government Area of Kwara State. The aim of the study was to provide a nuanced understanding of the extension services landscape, focusing on the experiences of small-scale farmers in a local government area of Nigeria. These farmers often operate within familial systems, relying on informal knowledge transfer and limited external support. Their resilience, though remarkable, is threatened by the changing demands of modern agriculture.

This study r sought to identify not only the challenges but also practical and locally appropriate solutions. The study investigated the sources of agricultural information, the crops cultivated, available extension services, perceived benefits, and the key constraints affecting extension service access. By understanding these dimensions, the research contributed to policy discussions and intervention strategies for strengthening extension systems in rural Nigeria.

Literature Review

Historical Development of Agricultural Extension Services

The historical development of agricultural extension services reflects a trajectory shaped by evolving agrarian practices, national policy shifts, and global development paradigms. In Nigeria, extension services began to formalise during the mid-20th century under government-led initiatives aimed at increasing agricultural productivity and tackling food insecurity. These services initially focused on top-down knowledge transfer from research institutions to farmers (Kumar et al., 2021).

The Green Revolution era marked a turning point in agricultural extension by introducing high-yield varieties, chemical inputs, and mechanisation. However, this approach often marginalised small-scale farmers due to a lack of adaptation to local conditions (Brown & Taylor, 2022). In response, more participatory and decentralised models have emerged in recent years, emphasising farmer involvement, gender inclusiveness, and sustainability.

Agricultural Extension Services in Contemporary Practice

Modern agricultural extension systems aim to bridge the gap between research outputs and farming practices by offering farmers information, training, and tools for improved decision-making (Singh & Jain, 2020). These services are delivered through a variety of methods including on-farm demonstrations, workshops, mobile platforms, and community outreach programmes (Tilak et al., 2020).

A shift toward demand-driven and decentralised extension models has occurred globally, with Nigeria following suit through programmes like the Agricultural Transformation Agenda Support Programme (ATASP) and the National Agricultural Extension and Research Liaison Services (NAERLS). Nonetheless, the capacity of these systems remains constrained by poor funding, inadequate staffing, and limited reach to rural communities (Ogunleye & Alabi, 2021).

Access to Agricultural Information

Access to agricultural information is crucial for empowering farmers with the knowledge needed to optimise yields, improve resilience, and engage competitively in markets. In Nigeria, radio remains a dominant source of

information for smallholder farmers, followed by cooperatives and informal networks (Ogungbade, 2019). Increasingly, mobile technologies and digital platforms are being adopted for real-time dissemination of market prices, weather forecasts, and pest control updates (Okorie & Adegbite, 2022).

Access to quality information has been shown to improve agricultural productivity and income (Adepoju et al., 2023). However, barriers such as language differences, digital illiteracy, and infrastructure deficits continue to hinder information flow in remote areas.

Challenges Facing Small-Scale Farmers in Nigeria

Small-scale farmers encounter numerous structural and systemic challenges, including limited access to inputs, credit facilities, modern technologies, and markets (Smith et al., 2019). Climate variability further compounds these issues through erratic rainfall, rising temperatures, and increased pest incidence (Jones & Brown, 2021).

Moreover, the fragmentation of agricultural extension services among multiple actors—government, NGOs, and private firms—often leads to duplication and gaps in service delivery (Ibrahim & Yakubu, 2021). A lack of tailored training programmes, coupled with weak linkages between research and extension, undermines the effectiveness of these services.

To improve outcomes, studies suggest that a more coordinated, well-funded, and farmer-centred approach is essential. Leveraging community-based networks and digital platforms can enhance information reach, while ongoing capacity-building efforts are necessary to equip extension agents with up-to-date knowledge (Eze & Nwachukwu, 2020).

Methodology

The study was conducted in Asa Local Government Area of Kwara State, Nigeria. Asa is predominantly agrarian with a high population of smallholder farmers engaged in crop production. A mixed-methods research design was employed to ensure comprehensive data collection, combining qualitative insights with quantitative analysis for triangulation and validation.

A two-stage sampling technique was adopted. In the first stage, three communities—Laduba, Budo Agun, and Ago Oja—were purposively selected based on their farming intensity and accessibility. In the second stage, a

simple random sampling technique was used to select respondents from each community. A total of 120 respondents were selected, representing approximately 40% of the farming population across the selected communities.

Data were collected using a structured questionnaire comprising both closed- and open-ended questions. The instrument was validated through expert review and piloted in a neighbouring local government area to ensure clarity and reliability. The questionnaire captured demographic information, sources of agricultural information, access to extension services, perceived benefits, and constraints.

Data were analysed using both descriptive and inferential statistics. Descriptive statistics such as frequencies, means, and percentages summarised the respondents' characteristics and responses. Inferential statistics, including regression analysis, were employed to determine the relationships between variables and to identify key factors influencing access to extension services.

Results and Discussion

Table 1: Distribution of Respondents Based on the Sources of Information Utilized by the Respondents

S/N	SOURCE OF INFORMATION	Frequency	Percentage
1	Agricultural extension services.	66	55.0
2	Farmer association and cooperatives.	87	72.5
3	Radio / Television.	93	77.5
4	Social media.	58	48.3
5	Local farmer network.	81	67.5
6	Newspaper.	39	32.5

Source: Field survey, 2024

Sources of Information Utilised by Respondents

Findings in Table 1 indicate that radio and television (77.5%) were the most widely used sources of agricultural information. This reflects the widespread accessibility and affordability of mass media. Farmer associations and cooperatives (72.5%) were also important, underscoring the social dynamics

of group-based knowledge sharing. Local farmer networks (67.5%) and extension services (55.0%) served as complementary sources. Although social media (48.3%) and newspapers (32.5%) were the least utilised, their growing relevance among digitally literate farmers suggests potential for future expansion. This supported Ogungbade (2019), who noted similar trends in Kwara State.

Types of Crops Cultivated

Table 2. Distribution of Respondents Based on the types of Crops Cultivated

TYPES OF CROPS CULTIVATED	Frequency	Percentage
Cassava	101	84.2
Maize	113	94.2
Potatoes	64	53.3
Rice	31	25.8
Beans (cowpea)	74	61.7
Yam	100	83.3
Vegetables	105	87.5
Plantain	57	47.5
Soya beans	43	35.8
Guinea corn	52	43.3

Source: Field survey, 2024

Table 2 reveals that maize (94.2%) was the most commonly cultivated crop, followed by vegetables (87.5%), cassava (84.2%), and yam (83.3%). These crops are staples in the region and contribute significantly to food security and household income. Beans (61.7%), potatoes (53.3%), and plantain (47.5%) were also fairly common. Crops like soybean, guinea corn, and rice were grown by less than half of the respondents. This pattern suggests a preference for crops with short gestation periods and high local demand, aligning with the findings of Abdulaleem et al. (2019).

Access to Agricultural Extension Services

Table 3. Distribution of Respondents Based on Use of Agricultural Extension Services

AGRICULTURAL EXTENSION SERVICES AVAILABLE	MOSTLY USED	OCCASIONALLY USED	RARELY USED	NOT USED	Mean	Rank
Farmer Cooperatives.	32 (26.7)	33 (27.5)	31 (25.8)	24 (20.0)	2.61	1st
Advisory services.	20 (17.5)	26 (21.7)	53 (44.2)	21 (16.7)	2.60	2nd
Market and value chain information.	23 (19.2)	39 (32.5)	37 (30.8)	21 (17.5)	2.53	3rd
Farm visits and Demonstrations.	20 (16.7)	37 (30.8)	14 (11.7)	49 (40.8)	2.23	4th
Non-Governmental Organizations.	19 (15.8)	29 (24.2)	15 (12.5)	57 (47.5)	2.08	5th
Awareness campaign.	13 (10.8)	31 (25.8)	22 (18.3)	54 (45.0)	2.02	6th
Agricultural agencies.	7(5.8)	29 (24.2)	31 (25.8)	52 (43.3)	1.95	7th
Financial supports.	12 (10.0)	24 (20.0)	11 (9.2)	73 (60.8)	1.79	8th
Training programs.	15 (12.5)	18 (15.0)	14 (11.7)	73 (60.8)	1.79	8th
Workshop.	7 (5.8)	14 (11.7)	22 (18.3)	77 (64.2)	1.59	10th

Source: Field survey, 2024

As presented in Table 3, farmer cooperatives (mean = 2.61) and advisory services (mean = 2.60) were the most frequently accessed forms of extension

support. These were followed by market and value chain information (2.53). Services such as farm visits, NGO support, and awareness campaigns were used less frequently, while training programmes and workshops were the least accessed (mean = 1.79 and 1.59 respectively). This indicates a gap in capacity-building initiatives, possibly due to poor outreach, resource constraints, or lack of farmer awareness. Enhancing training delivery could significantly improve knowledge uptake and innovation adoption.

Table 4: Distribution of Respondents Based on the Benefit of Agricultural Extension services

BENEFITS	SA	A	UD	D	SD	Mean	Rank
Access to market information and opportunities	38 (31.7)	28 (23.3)	2 (1.7)	26 (21.7)	26 (21.7)	3.22	1st
Access to farm demonstration and training programs.	39 (32.5)	32 (26.7)	0(0)	13(10.8)	36(30.0)	3.21	2nd
Enhance productivity and profitability	34 (28.3)	25 (20.8)	7 (5.8)	35 (29.2)	19 (15.8)	3.16	3rd
Provide valuable knowledge and guidance	34 (28.3)	29 (24.2)	2 (1.7)	31 (25.8)	24 (20.0)	3.15	4th
Improve communication and understanding	16 (13.3)	30 (25.0)	9 (7.5)	45 (37.5)	20 (16.7)	2.81	5th
Adoption of new technologies and practices.	29 (24.2)	28 (23.3)	3 (2.5)	8 (6.7)	52 (43.3)	2.78	6th
Proper infrastructure such as good roads and	12 (10)	35 (29.2)	8 (6.7)	43 (35.8)	22 (18.3)	2.76	7th

communication network							
Access to financial resources and government support programs.	20 (16.7)	29 (24.2)	2 (1.7)	7 (5.8)	62 (51.7)	2.48	8th

Source: Field survey, 2024

Table 4 highlights that farmers recognised access to market information (mean = 3.22) and training programmes (mean = 3.21) as the most beneficial aspects of extension services. Enhanced productivity (3.16), knowledge guidance (3.15), and communication improvement (2.81) also scored moderately. However, benefits related to technology adoption (2.78), infrastructure (2.76), and financial access (2.48) were rated lower, revealing structural limitations in service delivery. The findings support earlier claims by Adepoju et al. (2023) that farmers benefit most when extension services are aligned with market and training support.

Table 5: Distribution of Respondents Based on the Constraints in Accessing Agricultural Extension Services

CONSTRAINTS	SA	A	UD	D	SD	Mean	Rank
Inadequate funding and resources.	92 (76.7)	20 (16.7)	1 (0.8)	5 (4.2)	2 (1.7)	4.63	1st
Lack of training and education.	84 (70.0)	21 (17.5)	2 (1.7)	8 (6.7)	5 (4.2)	4.43	2nd
Limited access to technology and information resources.	71 (59.2)	34 (28.3)	2 (1.7)	11 (9.2)	2 (1.7)	4.34	3rd
Inadequate capacity building programs.	47 (39.2)	51 (42.5)	10 (8.3)	11 (9.2)	1 (0.8)	4.10	4th

Poor infrastructure and transportation difficulties.	31 (25.8)	73 (60.8)	5 (4.2)	7 (5.8)	4 (3.3)	4.00	5th
Lack of awareness about available agricultural extension services.	36 (30.0)	59 (49.2)	7 (5.8)	16 (13.3)	2 (1.7)	3.92	6th
Lack of access to market information and linkages.	39 (32.5)	44 (36.7)	9 (7.5)	20 (16.7)	8 (6.7)	3.72	7th
Language and cultural barriers	21 (17.5)	65 (54.2)	10 (8.3)	17 (14.2)	7 (5.8)	3.63	8th
Government policies and regulations.	34 (28.3)	27 (22.5)	8 (6.7)	7 (5.8)	44 (36.7)	3.00	9th

Source: Field survey, 2024

Table 5 shows that inadequate funding (mean = 4.63), lack of training (4.43), and limited access to technology (4.34) were the most critical constraints. Capacity-building gaps (4.10), poor infrastructure (4.00), and lack of awareness (3.92) were also significant. Challenges such as market access, language barriers, and government policy were considered less severe. These results echo Eze and Nwachukwu (2020), who argued for more coordinated investments in training, digital tools, and transport infrastructure to expand reach and impact of extension services.

Conclusion

This study has shown that although agricultural extension services were available in Asa Local Government Area of Kwara State, their utilisation among small-scale farmers remained limited. Farmers predominantly relied on radio, farmer cooperatives, and local networks to obtain agricultural information, while modern tools such as training workshops and digital platforms were under-utilised. The most cultivated crops included maize, vegetables, cassava, and yamstaples that reflect the nutritional and economic preferences of the region.

While farmers acknowledged several benefits from extension services, including improved market access and productivity, the study also uncovered considerable constraints. Inadequate funding, limited access to training, poor infrastructure, and insufficient technology remain significant challenges.

The findings underlined the need for robust policy frameworks and sustainable investment in extension services. Bridging the information and capacity gaps would require greater collaboration between government agencies, NGOs, and community-based organisations. Strengthening these systems is crucial for fostering innovation, improving agricultural productivity, and enhancing the livelihoods of small-scale farmers.

Recommendations

1. **Increase Government and Stakeholder Funding**: Improved financial support is critical for enhancing the quality and reach of extension services.
2. **Expand Training and Capacity Building**: Organise regular training sessions tailored to the specific needs of smallholder farmers.
3. **Leverage Cooperative Networks**: Strengthen farmer associations as platforms for information dissemination and resource pooling.
4. **Integrate Digital Tools**: Encourage the use of mobile-based and media-based information systems to expand access to agricultural advice and market data.
5. **Improve Infrastructure**: Investment in rural road networks and communication systems will facilitate easier access to extension services.
6. **Enhance Awareness and Outreach**: Intensify sensitisation efforts to inform farmers of the available extension resources and their benefits

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CHAPTER EIGHTEEN

Leveraging Earth Science Education in Environmental Sustainability in Africa

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Abstract

Environmental sustainability involves integrating sustainable practices and principles into environmental management. The knowledge of earth sciences is useful in the management of climate change, natural resources, including water, mineral and fossil fuels. The application of various aspects of earth sciences is pivotal in ecosystem and biodiversity conservation, soil health, sustainable agriculture and mitigation of natural disasters. In recent times, interdisciplinary approaches have been greatly utilised in understanding the exploration and exploitation of natural resources and their effect on human life. The aim of this study was to understand natural systems and make informed decisions that contribute to the health of humanity.

Keywords: Environmental sustainability, Earth sciences, Soil health, Mitigation.

Introduction

Africa is facing significant environmental sustainability challenges, including climate change (IPCC, 2020), deforestation (FAO, 2020), desertification (UNCCD, 2018), and pollution (UNEP, 2018). These challenges have severe impacts on the continent's ecosystems, economies, and human well-being (UNECA, 2019). Earth science education is critical in addressing these challenges by providing individuals with the knowledge, skills, and competencies needed to understand and manage the Earth's systems and resources sustainably (Huntoon & Lane, 2017). Despite the critical role of earth science education in promoting environmental sustainability, Africa continues to face significant environmental challenges. The lack of effective earth science education and awareness among African populations exacerbates these challenges, leading to inadequate management of natural resources,

increased vulnerability to environmental disasters, and decreased resilience to climate change (UNECA, 2019). Furthermore, the current state of earth science education in Africa is often characterised by inadequate infrastructure, insufficient funding, and a lack of qualified teachers, which hinders the development of a scientifically literate and environmentally conscious population (Huntoon and Lane, 2017). Therefore, there is a pressing need to harness earth science education in Africa to promote environmental sustainability, build resilience, and support sustainable development (Figure 1).

Harnessing earth science education in environmental sustainability in Africa is crucial for addressing the continent's pressing environmental challenges. This paper explored the potential of earth science education in promoting environmental sustainability in Africa, building on existing research that highlights the importance of earth science education in fostering sustainable development (Pedersen et al., 2018). By examining the current state of earth science education in Africa and identifying best practices for implementation, this paper aimed to contribute to the growing body of literature on earth science education and environmental sustainability (Kortz and van der Hoeven Kraft, 2016). The specific objectives of the study included assessing the current state of earth science education in Africa and its impact on environmental sustainability, building on existing research (Huntoon and Lane, 2017; Pedersen et al., 2018). Secondly, it aimed at identifying the key challenges and opportunities for harnessing earth science education in promoting environmental sustainability in Africa, drawing on the experiences of educators, policymakers, and practitioners (Kortz and van der Hoeven Kraft, 2016). Lastly, the study aimed at developing a framework for integrating earth science education into environmental sustainability initiatives in Africa, incorporating best practices and strategies from existing literature (UNESCO, 2019). The findings of this study would have implications for policy, practice, and future research in earth science education and environmental sustainability in Africa.



Figure 1: The Sustainable Development Goals (SDGS)

Overview of Earth Science Education in Africa

Earth science education in Africa is critical for promoting environmental sustainability, managing natural resources, and addressing the challenges of climate change (Huntoon and Lane, 2017). However, the current state of earth science education in Africa is characterised by several challenges, including limited access to quality education that is being faced by many African countries, particularly in rural and disadvantaged areas (UNESCO, 2019). Similarly, there is an inadequate infrastructure and resources including outdated textbooks, lack of laboratory equipment, and limited access to technology (Kigotho, 2017) where efforts were made to make the education available. This is complimented by shortage of qualified earth science teachers in many African countries, which can impact the quality of education and student outcomes (Bajah, 2018). Furthermore, the earth science curriculum in Africa often needs to be revised to address the specific environmental challenges and needs of the continent (Pedersen et al., 2018).

Despite these challenges, there are opportunities for improving earth science education in Africa. Such opportunities include integration of technology, such as digital resources and online learning platforms that can enhance access to quality earth science education in Africa (Kafyulilo, 2014). Such opportunities can also lead to the establishment of community-based learning

approaches that will help students to develop practical skills and apply earth science concepts to real-world problems (Machinga, 2018). In addition, partnerships and collaborations between African institutions and international organisations can provide opportunities for capacity building, resource sharing, and knowledge exchange (UNESCO, 2019). It is also worthy of note that earth science education can be designed to emphasise sustainability and environmental stewardship, promoting a culture of environmental responsibility among African students (Huntoon & Lane, 2017). By addressing the challenges and leveraging the opportunities, earth science education in Africa can play a critical role in promoting environmental sustainability and supporting the development of a more resilient and sustainable future.

Importance of Earth Science Education

Earth science education is crucial for promoting environmental sustainability in Africa. Some of the reasons why earth science education is important include, but are not limited to, understanding environmental systems, especially the complex relationships between human and natural systems, enabling the making of informed decisions about environmental management (Huntoon & Lane, 2017). Secondly, earth science education provides students with the knowledge and skills needed to address environmental challenges such as climate change, deforestation, and pollution (IPCC, 2020; FAO, 2020). Furthermore, earth science education can promote sustainable development by teaching students about the importance of sustainable resource management, environmental conservation, and social responsibility (UNESCO, 2019). In addition, earth science education help students to develop critical thinking skills, enabling them to analyse complex environmental issues and develop effective solutions (Kortz and van der Hoeven Kraft, 2016). Other importance of earth science education is in fostering environmental literacy among students, enabling them to understand the impact of human activities on the environment and make informed decisions about environmental issues (Pedersen et al., 2018). It provides students with a deep understanding of earth systems and environmental processes. Indeed, earth science education can play a critical role in promoting environmental sustainability in Africa (Figure 2).

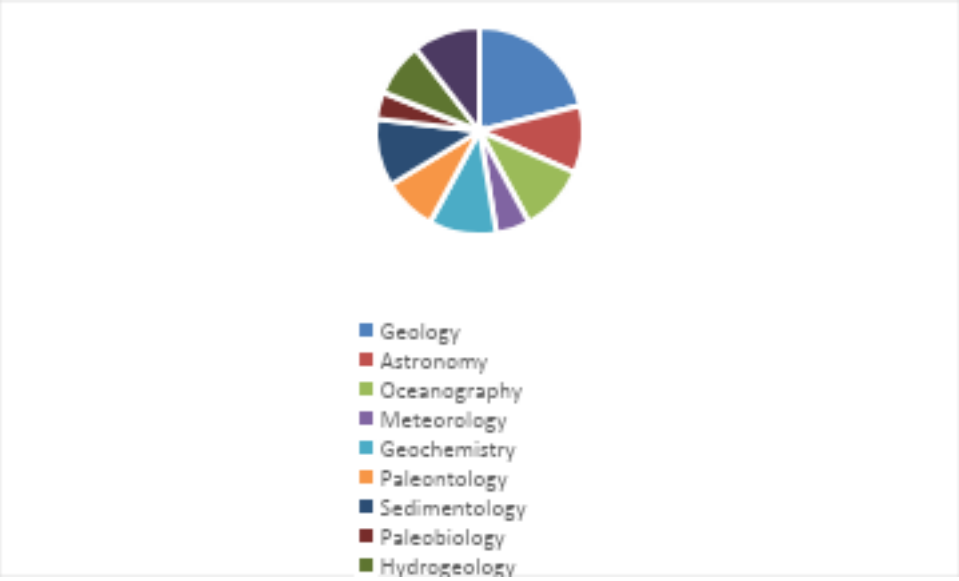


Figure 2: Some Branches of Earth Science

Environmental Sustainability Challenges in Africa

Africa faces numerous environmental sustainability challenges that impact the continent's ecosystems, economies, and human well-being. Some of the key challenges include: climate change which is a significant threat to Africa's environmental sustainability, with rising temperatures, changing precipitation patterns, and increased frequency of extreme weather events (IPCC, 2020). Deforestation and land degradation are another major environmental concern in Africa, with widespread clearance of forests for agriculture, urbanszation, and other purposes (FAO, 2020). Rich arrays of biodiversity are threatened or endangered due to habitat loss, pollution, and other human activities (IUCN, 2020). Many African countries are also faced with water scarcity challenges, with limited access to clean water for drinking, sanitation, and agriculture (UN Water, 2020). Other challenge is pollution, which is a significant environmental challenge in Africa, with air and water pollution affecting human health and the environment (UNEP, 2018). These environmental sustainability challenges have significant impact on Africa's ecosystems, economies, and human well-being, and require urgent attention and action.

Impact of Environmental Sustainability Challenges

The impact of environmental sustainability challenges facing Africa have significantly impacted the continent through environmental degradation. This leads to loss of ecosystem services, including clean air and water, soil formation, and climate regulation (MEA, 2005). Environmental sustainability challenges can impact food security, particularly in areas where agriculture is a major source of livelihood (FAO, 2020). Human health impact from pollution and degradation, including increased risk of disease and mortality, is another growing area of concern from the poorly managed environment (WHO, 2018). It is also worth mentioning that environmental sustainability challenges can have significant economic impacts that include loss of productivity, increased costs, and decreased economic opportunities (UNECA, 2019).

Impact of Human Activities on the Environment

Human activities have a significant impact on the environment, affecting ecosystems, biodiversity, and the planet's natural resources. Some of the key impacts of human activities on the environment include the burning of fossil fuels and deforestation, which have led to an increase in greenhouse gas emissions, contributing to climate change (IPCC, 2020). Human activities, such as agriculture, urbanisation, and logging, have led to widespread deforestation and land degradation, resulting in loss of biodiversity and ecosystem disruption (FAO, 2020). Activities, such as industrial processes, transportation, and waste disposal, have led to pollution of the air, water, and soil, affecting human health and the environment (UNEP, 2018). Other activities, such as over-extraction of groundwater and pollution of water sources, have led to water scarcity, affecting human consumption, agriculture, and ecosystems (UN Water, 2020). Human activities, such as habitat destruction, overfishing, and pollution, have led to loss of biodiversity, affecting ecosystem function and resilience (IUCN, 2020).

Consequences of Human Impact on the Environment

Many human activities have led to environmental degradation, affecting ecosystem function and resilience (MEA, 2005). Environmental pollution and degradation can have significant human health impacts, including increased risk of disease and mortality (WHO, 2018). Environmental degradation can also have significant economic impact, including loss of productivity,

increased costs, and decreased economic opportunities (UNECA, 2019). Similarly, environmental degradation can also have significant social impact, including displacement of communities, loss of livelihoods, and social inequality (UNDP, 2020).

Mitigating the Impact of Human Activities on the Environment

To mitigate the impact of human activities on the environment, it is essential to adopt sustainable practices and reduce environmental degradation. Some strategies for mitigating the impact of human activities on the environment involve adopting sustainable resource management practices that can help reduce environmental degradation and promote ecosystem resilience (UNEP, 2018). Transitioning to renewable energy sources can help reduce greenhouse gas emissions and mitigate climate change (IRENA, 2020) while conserving and restoring natural habitats can help promote biodiversity and ecosystem resilience (IUCN, 2020).

Role of Earth Science Education in Addressing Environmental Sustainability Challenges

Earth science education plays a critical role in addressing environmental sustainability challenges by providing individuals with the knowledge, skills, and competencies needed to understand and manage the Earth's systems and resources sustainably. Some of the ways earth science education can contribute to addressing environmental sustainability challenges include promotion of environmental literacy among students, enabling them to understand the impact of human activities on the environment and make informed decisions about environmental issues (Pedersen et al., 2018). Earth science education also helps students in developing critical thinking skills, enabling them to analyse complex environmental issues and develop effective solutions (Kortz and van der Hoeven Kraft, 2016). It fosters sustainable development by teaching students about the importance of sustainable resource management, environmental conservation, and social responsibility (UNESCO, 2019). The art of earth science education is crucial for students understanding of the causes and consequences of climate change, and development of strategies for mitigating and adapting to its impacts (IPCC, 2020).

It can promote sustainable resource management by teaching students about the importance of conserving and managing natural resources sustainably (UNEP, 2018).

Strategies for Integrating Earth Science Education into Environmental Sustainability Initiatives

Integrating earth science education into environmental sustainability initiatives can help promote sustainable development and environmental conservation. Some strategies for integrating earth science education into environmental sustainability initiatives may involve integrating earth science education with other disciplines, such as biology, chemistry, and social sciences, which can provide a holistic understanding of environmental sustainability issues (UNESCO, 2019). Using project-based learning approaches can help students develop practical skills and apply earth science concepts to real-world environmental sustainability challenges (Kortz & van der Hoeven Kraft, 2016). Community-based learning approaches can help students develop a deeper understanding of environmental sustainability issues and promote community engagement and participation (Machinga, 2018). Incorporating local contexts and case studies into earth science education can help students understand the relevance of earth science concepts to environmental sustainability issues in their own communities (Pedersen et al., 2018). Using technology, such as digital resources and online learning platforms, can enhance access to earth science education and promote environmental sustainability (Kafyulilo, 2014).

Benefits of Integrating Earth Science Education into Environmental Sustainability Initiatives

The benefit of integrating earth science education into environmental sustainability initiatives embraces integrating earth science education into environmental sustainability. Such initiatives can promote sustainable development and environmental conservation (UNESCO, 2019). Earth science education can help students develop environmental literacy, enabling them to understand the impact of human activities on the environment (Huntoon and Lane, 2017). Furthermore, integrating earth science education into environmental sustainability initiatives can foster critical thinking and problem-solving skills among students (Kortz and van der Hoeven Kraft, 2016).

Challenges and Opportunities

While integrating earth science education into environmental sustainability initiatives offers many benefits. There are also challenges and opportunities to consider. Some of these include limited resources, including funding and infrastructure (Kigotho, 2017). Interdisciplinary collaboration between earth science educators and environmental sustainability practitioners can provide opportunities for developing innovative and effective solutions (UNESCO, 2019).

Inadequate infrastructure, including classrooms, laboratories, and technology can hinder the implementation of earth science education programmes (UNEP, 2018) while a lack of trained teachers and educators can pose challenges to implementing earth science education programmes, particularly in rural and underserved areas (UNESCO, 2019). Cultural and linguistic barriers can equally affect the effectiveness of earth science education programmes, particularly in diverse and multilingual contexts (UNESCO, 2019). Other factor is the passive threat of the indigenous as a result of limited community engagement and participation because of their skills. This is capable of hindering the effectiveness of earth science education programmes and limiting their impact on environmental sustainability (Machinga, 2018).

Best Practices for Implementation

Implementing earth science education for environmental sustainability in Africa requires careful planning, collaboration, and stakeholder engagement. The best practices for the implementation of earth science education in environmental sustainability in Africa will involve engagement with local communities, governments, and other stakeholders to ensure that earth science education programmes are relevant, effective, and sustainable (UNESCO, 2019). The use of interdisciplinary approaches that integrate earth science education with other disciplines, such as biology, chemistry, and social sciences, to provide a holistic understanding of environmental sustainability issues (Pedersen et al., 2018), would be crucial. Practical training and hands-on experience for students to develop skills and apply earth science concepts to real-world environmental sustainability challenges should be a must for them (Kortz & van der Hoeven Kraft, 2016). Capacity-building programmes for teachers, educators, and community leaders to enhance their knowledge and skills in earth science education and environmental sustainability should

be formulated (SAEON, 2020). A continuous monitoring and evaluation framework to assess the effectiveness of earth science education programmes and identify areas for improvement (UNEP, 2018) is of utmost importance for the successful implementation.

Alignment of Earth Science Education with SDGs

Earth science education can contribute significantly to achieving the Sustainable Development Goals (SDGs), particularly those related to environmental sustainability and climate action. Earth science education can help students understand the causes and consequences of climate change, and develop strategies for mitigating and adapting to its impact (IPCC, 2020). Secondly, earth education can also support the achievement of SDG 14, which deals with life below water. Earth science education can promote understanding of ocean systems, marine ecosystems, and the impact of human activities on the ocean environment (UNESCO, 2019). Thirdly, it can also significantly enhance SDG 15, which deals with life on land. Earth science education can help students understand the importance of terrestrial ecosystems, biodiversity, and sustainable land management practices (UNEP, 2018).

Addressing the Challenges

To address the challenges earlier highlighted, it is essential to build partnerships with governments, civil society, and the private sector to leverage resources and expertise (AFR100, 2020). It is equally important to develop contextualised curricula that take into account local cultures, languages, and environmental sustainability issues (Pedersen et al., 2018). Government and corporate bodies would have to invest in infrastructure, including classrooms, laboratories, and technology, to support the implementation of earth science education programmes (UNEP, 2018). The teachers should be provided with training and capacity-building programmes to enhance the knowledge and skills of educators in earth science education and environmental sustainability (SAEON, 2020).

Educational Strategies

An interdisciplinary approach is a pivotal strategy in educational sustainability, connecting all aspects of earth science with life sciences, social sciences, economics, ethics, and policy. Place-based learning that involves

teaching through local environmental issues will help in managing communities with peculiar challenges. Engaging students in real-world sustainability challenges through project-based learning should be encouraged. Use of technology and modeling tools, such as GIS, remote sensing, and simulations to understand mitigation and sustainability, is crucial.

Roles of Students

The role of students in environmental sustainability is important considering their ability to combine education, action and innovation. Students are brought to enhance understanding the interconnections in Earth's systems, critical thinking, problem-solving skill, collaboration and communication, ethical reasoning and civic responsibility (Figure 3). Students play important role as learners, change- agents and future stewards of the earth. By being well educated, equipped, responsible and proactive, they can drive meaningful and impactful change and help build a more sustainable world.



Figure 3: Some students and a tutor studying the environment in part of Northcentral Nigeria

Opportunities for Collaboration and Partnership

Collaboration and partnership are essential for harnessing earth science education to promote environmental sustainability in Africa. Some opportunities for collaboration and partnership include:

Government-Private Sector Partnerships that involved partnering with governments and the private sector to provide access to resources, expertise, and funding for earth science education initiatives (AFR100, 2020). Collaborating with international organisations and institutions can provide access to global best practices, expertise, and resources for earth science education (UNESCO, 2019). Engaging with local communities and stakeholders can help ensure that earth science education initiatives are relevant, effective, and sustainable (Machinga, 2018). Partnering with other disciplines, such as biology, chemistry, and social sciences, can provide a holistic understanding of environmental sustainability issues (Pedersen et al., 2018). Others include utilising digital platforms and technologies that provide opportunities for collaboration, knowledge sharing, and capacity building in earth science education (Kafyulilo, 2014).

Benefits of Collaboration and Partnership

The benefits of collaboration and partnership in earth science education for environmental sustainability helps in providing access to increased resources, including funding, expertise, and infrastructure (AFR100, 2020). Collaboration and partnership can improve the effectiveness of earth science education initiatives by leveraging global best practices and expertise (UNESCO, 2019). It enhances the sustainability of earth science education initiatives by promoting community engagement and ownership (Machinga, 2018).

Benefits of Collaboration and Partnership

The benefits of collaboration and partnership in earth science education for environmental sustainability will provide access to increased resources, including funding, expertise, and infrastructure (AFR100, 2020). It also Improve earth science education initiatives by leveraging global best practices and expertise (UNESCO, 2019) and enhance the sustainability of earth science education initiatives by promoting community engagement and ownership (Machinga, 2018).

Conclusion

Implementing earth science education for environmental sustainability in Africa requires careful planning, collaboration, and stakeholder engagement. By addressing the challenges and leveraging opportunities, promotion of sustainable development and environmental conservation in Africa can be achieved. Schools and universities should emphasise integrating sustainability into earth and environmental science programmes. The role of teachers, lecturers and researchers are important for continuous learning. Adherence to government policies, implementation government laws and community partnerships for sustainability projects like international programs can foster and improve environmental sustainability. Collaboration and partnership are essential for harnessing earth science education to promote environmental sustainability in Africa. By leveraging resources, expertise, and funding, effective earth science education initiatives that promote sustainable development and environmental conservation can be developed.

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CHAPTER NINETEEN

Adult Perspectives on Street Begging in Sango, Ilorin: Public Health, Social Vulnerability, and Sustainable Policy Implications

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Abstract

Street begging poses public health and social sustainability challenges, especially in low- and middle-income countries like Nigeria. Its local causes and effects are underexplored. It is against this background that this study sought to assess perceived causes, consequences, and mitigation strategies for street begging among adults in Sango, Ilorin, Nigeria. The study adopted a cross-sectional design with 460 adults selected through a multistage sampling procedure for a structured interview, using a semi-structured interviewer-administered questionnaire. Data collected were analysed using descriptive statistics and chi-square tests at $p<0.05$. Poverty, disability, and family breakdown were found to be the key causes of street begging, while consequences included sexual violence and assault. The study recommended that street begging reflects deep-rooted social vulnerabilities needing sustainable policy solutions like the establishment of destitute centres and the provision of financial aid for the destitute and disabled.

Keywords: Homeless Persons, Poverty, Public Health, Welfare Services.

Introduction

Street begging is a persistent global issue with deep socio-economic and public health implications. While prevalent in many low- and middle-income countries, it takes on particularly troubling dimensions in Nigeria where structural inequalities, poverty, cultural factors, and weakened social systems converge to drive the phenomenon. According to Stones (2013), while poverty remains the most cited precipitant of begging, psychosocial factors such as

stigma, disempowerment, and exclusion are equally critical. Street begging in Nigeria—commonly known as *Bara* or *Maula* —is particularly pronounced in the north and continues to grow despite legal and social deterrents (Fawole et al., 2011).

The phenomenon increasingly includes not only people with visible disabilities but also able-bodied individuals, children, and entire families using strategic locations—markets, mosques, and traffic intersections—as sites of solicitation. Agyemang et al. (2024) underscored the evolving nature of the street begging economy, identifying it as a form of informal employment with embedded survival strategies, social networks, and resource-sharing dynamics. This evolution reflects a shift from mere destitution to a semi-organised livelihood, further complicating intervention strategies.

Ilorin Metropolis, located in Kwara State, is one of Nigeria's rapidly urbanizing centers grappling with this issue. Existing studies, such as Tambawal (2012) and Onoyase (2010), suggested that ineffective enforcement, inadequate social protection, and religious leniency have contributed to the normalisation of street begging. Beggars often exploit religious sensibilities and societal empathy to sustain this practice, creating a complex interplay between vulnerability and opportunism. Despite the visibility of beggars across the city, there is limited empirical data addressing the public's perception of the causes, consequences, and possible interventions—particularly from within affected communities.

This study, therefore, sought to fill this gap by assessing the perceived drivers and consequences of street begging in a Hausa-dominated community in Ilorin, triangulating these insights with socio-cultural, public health, and policy perspectives. By identifying context-specific factors and locally endorsed intervention strategies, this work contributed to a sustainable and community-informed approach to mitigating street begging.

Methodology

This descriptive cross-sectional study was conducted between February and March 2024 among adult residents of the Sango community in Ilorin Metropolis, Kwara State. The location was purposively chosen for its high prevalence of street begging, especially among Hausa migrants. A sample size of 460 was determined using Fisher's formula, accounting for a confidence

level of 95% and an estimated prevalence of 50% due to the lack of prior localised data.

A multistage sampling technique was employed. First, Sango was selected as the study community. Next, systematic random sampling was used to identify households, and one eligible adult per household was randomly selected for participation. Eligibility criteria included adults aged 18 and above who had lived in the community for at least one year.

Data were collected over six weeks, using a semi-structured interviewer-administered questionnaire, which captured socio-demographic data, perceived causes and consequences of street begging, and opinions on mitigation strategies. The tool was adapted from previous instruments used in similar studies (Fawole et al., 2011; Ekebosi et al., 2021) and further enriched using concepts from the studies by Stones (2013) and Agyemang et al. (2024) regarding psychosocial and economic dynamics.

The questionnaire was pre-tested in Offa, a nearby community, using 10% of the final sample size. Necessary adjustments were made for cultural sensitivity and clarity. Ethical approval was obtained from the Ethical Review Committee of the University of Ilorin with the approval number UERC/ASN/2024/2680. Written informed consent was obtained from all participants.

Data were analysed using STATA version 11. Descriptive statistics were presented in frequencies and percentages, while chi-square tests were used to assess associations between categorical variables. Logistic regression was used to identify predictors of street begging. A p-value < 0.05 was considered statistically significant.

Results

Table 1: Socio-demographic Profile of Respondents in the Study Population

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	< 20	42	9.2%
	20 – 39	200	44.0%
	40 – 59	179	39.3%

Variable	Category	Frequency (n)	Percentage (%)
	≥ 60	34	7.5%
Gender	Male	222	48.8%
	Female	233	51.2%
Tribe	Yoruba	85	18.7%
	Hausa	359	78.9%
	Igbo	3	0.7%
	Other	8	1.7%
Religion	Islam	427	93.9%
	Christianity	26	5.7%
	Other	2	0.4%
Marital Status	Single	96	21.1%
	Married	285	62.6%
	Divorced	74	16.3%
Education Level	Primary	102	22.4%
	Secondary	136	29.9%
	Tertiary	41	9.0%
	Other (e.g., informal education)	176	38.7%
Type of Housing	Mud	8	1.8%
	Mud plastered with cement	125	27.5%
	Block	305	67.0%
	Wooden	17	3.7%
Occupation	Civil Servant	23	5.1%
	Personal Business	275	60.4%

Variable	Category	Frequency (n)	Percentage (%)
	Housewife	78	17.2%
	Artisans	27	5.9%
	Unemployed	52	11.4%

Table 1 outlines the socio-demographic characteristics of the 455 respondents. The majority (44.0%) were aged between 20 and 39 years, with slightly more female (51.2%) than male. Most respondents were Hausa (78.9%) and predominantly Muslim (93.9%), reflecting the cultural and religious demographics of the study area. A large proportion were married (62.6%), and education levels were varied, though a notable 38.7% had only informal or unspecified education. Most respondents lived in block houses (67.0%), indicating moderate housing quality. Economically, the dominant occupation was personal business (60.4%), while 11.4% were unemployed. These demographics suggest a youthful, economically active, yet educationally diverse population, with potential social vulnerabilities influencing practices like street begging.

Table 2: Prioritized Perceptions of the Underlying Causes of Street Begging Among Respondents

Perceived Causes	Strongly Agree (SA)	Agree (A)	Total Agreement (SA + A)
Poverty	276 (60.7%)	150 (32.9%)	426 (93.6%)
Physical disability	83 (18.2%)	279 (61.3%)	362 (79.5%)
Death of both parents / Family disintegration	53 (11.7%)	247 (54.3%)	300 (66.0%)
Lack of old age security	48 (10.5%)	195 (42.9%)	243 (53.4%)
Religious obligation	62 (13.6%)	175 (38.5%)	237 (52.1%)

Perceived Causes	Strongly Agree (SA)	Agree (A)	Total Agreement (SA + A)
Treating sickness	69 (15.2%)	173 (38.0%)	242 (53.2%)
Children's education	66 (14.5%)	164 (36.0%)	230 (50.5%)
Lack of caring relatives	77 (16.9%)	163 (35.8%)	240 (52.7%)
Source of livelihood	78 (17.1%)	156 (34.3%)	234 (51.4%)
Health problems	49 (10.7%)	180 (39.6%)	229 (50.3%)
Unemployment	50 (11.0%)	161 (35.4%)	211 (46.4%)
Family rejection	52 (11.4%)	178 (39.2%)	230 (50.6%)
Old age	50 (11.0%)	200 (43.9%)	250 (54.9%)
Homelessness	49 (10.8%)	165 (36.3%)	214 (47.1%)
National disaster	56 (12.3%)	162 (35.6%)	218 (47.9%)
Culture	61 (13.4%)	176 (38.7%)	237 (52.1%)
Family heritage	48 (10.5%)	182 (40.0%)	230 (50.5%)
Considering begging as a job	49 (10.8%)	175 (38.5%)	224 (49.3%)
Rural-urban migration	61 (13.4%)	173 (38.0%)	234 (51.4%)

Perceived Causes	Strongly Agree (SA)	Agree (A)	Total Agreement (SA + A)
Civil war	65 (14.3%)	169 (37.1%)	234 (51.4%)
Psychiatric disorder	58 (12.8%)	172 (37.8%)	230 (50.6%)

Table 2 presents respondents' perceptions of the causes of street begging, with poverty identified as the most significant factor (93.6% agreement), followed by physical disability (79.5%) and family breakdown (66.0%). Health-related factors, lack of social support, and religious obligations were also widely acknowledged. Surprisingly, factors like unemployment, homelessness, and considering begging a livelihood were agreed upon by nearly half of respondents. Cultural beliefs, psychiatric issues, and civil conflict were also moderately endorsed. These findings suggest that street begging is perceived as a consequence of both structural socio-economic challenges and individual or familial vulnerabilities, underscoring the need for multidimensional intervention strategies.

Table 3: Perceived Risks and Vulnerabilities Linked to Street Begging Among Respondents

Perceived Consequences	SA n(%)	A n(%)	N n(%)	D n(%)	SD n(%)
Sexual violence	171(37.6)	149(32.8)	11(2.4)	52(11.4)	72(15.8)
Accident	59(12.9)	258(56.8)	8(1.7)	85(18.7)	45(9.9)
Physical assault	45(9.9)	266(58.5)	6(1.3)	92(20.2)	46(10.1)
Victim of crime	54(11.9)	219(48.1)	9(2.0)	93(20.4)	80(17.6)
Harsh weather	87(19.1)	195(42.9)	6(1.3)	86(18.9)	81(17.8)
Verbal abuse	73(16.0)	199(43.7)	6(1.4)	100(22.0)	77(16.9)
Harassment from municipal officials and police	79(17.4)	207(45.5)	6(1.3)	95(20.9)	68(14.9)

Harassment from fellow Beggers	64(14.0)	208(45.7)	8(1.8)	98(21.6)	77(16.9)
Discrimination and stigmatization	81(17.8)	221(48.6)	7(1.5)	93(20.4)	53(11.7)
Problems of shelter and food	77(16.9)	192(42.2)	9(2.0)	76(16.7)	101(22.2)

Table 3 highlights respondents' perceptions of the adverse consequences linked to street begging. Sexual violence was strongly acknowledged, with 70.4% either strongly agreeing or agreeing to its prevalence. Physical assault (68.4%) and accidents (69.7%) were also widely recognised dangers. Other significant concerns included exposure to harsh weather, verbal abuse, and harassment from both authorities and fellow beggars. Discrimination and stigmatisation were acknowledged by 66.4% of respondents. Notably, while problems of shelter and food were recognised, agreement levels were slightly lower (59.1%). Overall, the data underscored that street begging is perceived as exposing individuals to multiple physical, emotional, and social harms.

Table 4: Respondents' Perceptions of Effective Strategies for Mitigating Street Begging

Perceived Measures of Mitigating Street Begging	YES n(%)	NO n(%)
Establishment of destitute centres	407(89.4)	48(10.6)
Payment of allowances to disabled persons	352(77.4)	103(22.6)
Strengthening of social welfare agencies across the state	304(66.8)	151(33.2)
Forcing beggars out of the streets	272(59.9)	183(40.2)
Arresting anyone found begging on the public streets	257(56.5)	198(43.5)
Establishment of financial assistance programmes for the less privileged in the state	270(59.3)	185(40.7)
Religious control measures	272(59.8)	183(40.2)

Table 4 illustrates respondents' perspectives on various strategies to mitigate street begging. The most supported measure is the establishment of destitute centers (89.4%), followed by financial support for disabled persons (77.4%) and strengthening of social welfare agencies (66.8%). While a majority also favoured enforcement-based strategies such as forcing beggars off the streets (59.9%) and arrests (56.5%), these approaches received comparatively less support. Just under 60% advocated for financial assistance programmes and religious control measures. Overall, the findings suggested that while there is strong support for welfare-driven interventions, a considerable proportion of respondents also endorsed punitive or regulatory measures.

Table 5: Demographic Profile and Frequency of Street Begging Among Respondents

Variable	Frequency	Percentage
Ever Engaged in Street Begging		
Yes	119	26.0
No	336	74.0
Duration of Onset of Street Begging (Years)		
< 1	60	50.4
1 - 4	36	30.3
> 4	23	19.3
Age at Onset of Street Begging		
< 18	84	70.6
≥ 18	35	29.4
Currently Engaged in Street Begging		
Yes	119	26.0
No	336	74.0
Other Family Members Engage in Street Begging		
Yes	96	80.7
No	23	19.3

Family Members Practicing Street Begging	38	39.6
Spouse	38	39.6
Children	20	20.8
Others	101	84.9
Frequency of Practice of Street Begging	18	15.1
Everyday		
Once a while		

Table 5 presents data on respondents' involvement in street begging, revealing that 26% engaged in the practice, with most beginning before age 18 (70.6%). Among those who begged, over half had done so for less than a year, suggesting a recent surge or transient need. A significant proportion (26%) were still actively begging, and 80.7% reported having other family members also involved, indicating intergenerational or household-level dependence. Spouses and children were equally represented among family beggars. The majority (84.9%) begged daily, emphasising the severity and regularity of the practice. These findings highlight the entrenched and systemic nature of street begging.

Table 6: Demographic Correlates of Street Begging Among Respondents

Variable	Practice		Total	χ^2	p-value
	Yes	No	N= 455(100%)		
	n=119 (26%)	n=336 (74%)			
Age in years					
<20	13(30.9)	29(69.1)	42(9.2)		
20-39	58(29.0)	142(71.00)	200(434.0)		
40-59	40(22.4)	139(77.6)	179(39.3)		
60 and above	8(23.5)	26(76.5)	34(7.5)	2.8044	0.423
Gender					
Male	42(18.9)	180(81.1)	222(48.8)		

Female	77(33.1)	156(66.9)	233(51.2)	11.7493	**0.001**
Tribe					
Yoruba	32(37.6)	53(62.4)	85(18.7)		
Hausa	86(24)	273(76.0)	359(78.9)		
Igbo	0(0.0)	3(100.0)	3(0.7)		
Other	1(12.5)	7(87.5)	8(1.7)	8.5466	**0.036**
Religion					
Islam	110(25.8)	317(74.2)	427(93.9)		
Christianity	9(34.6)	17(65.4)	26(5.7)		
Others	0(0.0)	2(100.0)	2(0.4)	1.7063	0.426
Marital status					
Single	34(35.4)	62(64.6)	96(21.1)		
Married	61(21.4)	224(78.6)	285(62.6)		
Divorced	24(32.4)	50(67.6)	74(16.3)	9.1051	**0.011**
Education status					
Primary	24(23.5)	78(76.5)	102(22.4)		
Secondary	39(28.7)	97(71.3)	136(30.0)		
Tertiary	12(29.3)	29(70.7)	41(9.0)		
Others	1(8.3)	11(91.7)	12(2.6)		
None	43(26.2)	121(73.8)	164(36.0)	2.9913	0.559
Type of house					
Mud	1(12.5)	7(87.5)	8(1.8)		
Mud plastered with cement	41(32.8)	84(67.2)	125(27.5)		
Block	73(23.9)	232(76.1)	305(67.0)		
Wooden	4(23.5)	13(76.5)	17(3.7)	4.4695	0.215

Occupation					
Civil servant	7(30.4)	16(69.6)	23(5.1)		
Personal business	69(25.1)	206(74.9)	275(60.4)		
Housewife	20(25.6)	58(74.4)	78(17.1)		
Artisans	9(33.3)	18(66.7)	27(6.0)		
Unemployed	14(26.9)	38(73.1)	52(11.4)	1.1263	0.890
Average monthly income					
<10.000	106(26.7)	291(73.3)	397(87.3)		
10,000 – 50,000	5(15.6)	27(84.4)	32(7.0)		
>50,000	8(30.8)	18(69.2)	26(5.7)	2.1849	0.335

Table 6 presents the relationship between respondents' demographic characteristics and their involvement in street begging. Significant associations were found with gender, tribe, and marital status. A higher proportion of female (33.1%) engaged in street begging compared to male (18.9%), indicating a gender-based vulnerability ($p = 0.001$). Tribal affiliation was also significant ($p = 0.036$), with the Yoruba group showing the highest involvement (37.6%), while no Igbo respondents reported engaging in begging. Marital status showed a notable association ($p = 0.011$), as single and divorced individuals were more likely to beg than their married counterparts.

Although not statistically significant, trends suggest that younger individuals, those with no education, and those earning less than ₦10,000 monthly are more likely to engage in street begging. Similarly, those in mud-plastered houses and unemployed or informal workers showed higher rates of begging. However, religion, education level, type of housing, occupation, age, and income did not show significant statistical associations. These findings highlighted that while economic factors are relevant, social and cultural variables such as gender roles, marital status, and ethnicity play a stronger role in influencing street begging behaviour in this population.

Discussion

This study offered a nuanced understanding of the multifactorial drivers and consequences of street begging in Ilorin, Nigeria. Poverty was overwhelmingly perceived as the main cause (93.6%), consistent with findings by Stones (2013) and Agyemang et al. (2024), who described poverty as both a trigger and a sustainer of begging economies. The recognition of physical disability (79.5%) and family disintegration (66.0%) as significant contributors aligns with global literature on structural vulnerability (Tambawal, 2012; Ekebosi et al., 2021).

Interestingly, the findings also highlighted the influence of religious obligation and cultural practices in sustaining begging, echoing Onoyase's (2010) observation that religious sympathy often enables the practice under the guise of charity. This duality—where beggars exploit religious beliefs while the public feels morally obliged to give—creates a persistent enabling environment.

The perceived consequences of begging, such as exposure to sexual violence (70.4%), accidents (69.7%), and physical assault (68.4%), resonate with Hasibuan et al. (2020), who documented the physical and emotional abuse faced by street children in Indonesia. This suggests that beyond economic deprivation, street begging exposes individuals—particularly women and children—to heightened health and safety risks.

The widespread support for establishing rehabilitation centers (89.4%) and financial assistance for the disabled (77.4%) underscores public awareness of the structural causes and a preference for social interventions over punitive ones. Nonetheless, the relatively high endorsement of coercive measures, such as arrests (56.5%) and street clearance (59.9%), reflects an underlying tension between empathy and fatigue among urban dwellers, a sentiment similarly noted by Stones (2013).

Demographic associations, such as the higher prevalence of begging among females, single/divorced individuals, and the Yoruba ethnic group, revealed gendered and cultural dimensions of vulnerability. Although education and income were not significantly associated, the high proportion of beggars with no or low formal education points to limited economic mobility and capacity for self-reliance.

In triangulating these findings, it becomes evident that street begging in Ilorin is not merely a result of individual failings but reflects broader systemic dysfunctions. The normalisation of begging as a livelihood strategy, as described by Agyemang et al. (2024), mirrors the evolution seen in Ghana and other urban contexts. Hence, effective interventions must transcend short-term relief and incorporate sustainable development, education, skills empowerment, and inclusive social welfare systems.

Limitations

This study is not without limitations. Firstly, it was geographically confined to the Sango community within Ilorin, which may limit the generalisability of the findings to other regions with different socio-cultural, economic, and religious compositions. Secondly, the reliance on self-reported data introduced potential response biases, including social desirability bias and recall inaccuracies, which might have affected the reliability of participants' responses. The use of a cross-sectional design also restricted the ability to establish causal relationships between the identified sociodemographic factors and engagement in street begging. Furthermore, the study employed a predominantly quantitative approach, which might not fully capture the subjective experiences, motivations, and emotional realities of individuals involved in street begging. Future studies may benefit from mixed-methods designs and broader geographical coverage to enrich and validate these findings.

Implications for Policy and Practice

The findings of this study carry significant implications for both policy development and practical interventions aimed at addressing the persistent issue of street begging in urban Nigerian settings. First and foremost, the widespread public support for welfare-based solutions, such as the establishment of rehabilitation centers and financial assistance for persons with disabilities, highlights an urgent need to strengthen and expand social protection systems. Policymakers are therefore encouraged to invest in comprehensive and inclusive welfare programmes that target vulnerable populations, particularly individuals with disabilities, single-parent households, and street-involved families.

Furthermore, the health risks associated with street begging, such as sexual violence, physical assault, exposure to harsh environmental conditions, and

inadequate access to basic healthcare, demonstrate the necessity of framing street begging as a pressing public health issue. Integrating street populations into public health outreach initiatives, including routine immunisation, mental health services, and mobile clinics, could contribute significantly to mitigating these risks and improving community well-being.

In addition, the findings suggest that economic empowerment and education are vital for breaking the cycle of dependency associated with begging. Vocational training and skills acquisition programmes tailored to low-income urban residents could offer meaningful alternatives to begging, especially for women and youth. Such initiatives would not only foster self-reliance but also reduce the intergenerational transmission of poverty and social marginalization.

While some respondents expressed support for punitive measures, such as arrests or the forced removal of beggars, the broader data advocated for a more balanced and humane approach. Legal reforms should move away from criminalising begging and instead prioritise mechanisms that connect individuals to support services, thereby aligning with human rights and social justice principles.

Finally, the cultural and religious dimensions of street begging call for the active engagement of faith-based organizations and community leaders. These institutions can play a pivotal role in reshaping public perceptions, promoting dignity-centered interventions, and advocating for compassionate responses to poverty and vulnerability.

Conclusion

Street begging in Ilorin is deeply rooted in socio-economic deprivation, cultural norms, and weak social support systems. This study demonstrated that the practice is both a livelihood strategy and a manifestation of structural inequality. With a high prevalence of health and social vulnerabilities among beggars, there is a clear public demand for sustainable solutions that blend compassion with systemic reform. Interventions must prioritise the establishment of inclusive social welfare programs, healthcare access, education, and skills empowerment while addressing cultural and religious dimensions. Ultimately, tackling street begging requires a coordinated, multi-sectoral, multi-dimensional approach that balances social responsibility with public health imperatives.

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CHAPTER TWENTY

Global University Networks: Strengthening Collective Impact in Higher Education

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Abstract

Global University Networks (GUNs) are increasingly vital strategic alliances that enable higher education to tackle complex global challenges. They amplify collective impact through cross-border collaboration, resource sharing, and innovation. GUNs enhance educational quality, cultivate global perspectives, and improve graduate employability via student and faculty exchange, joint degrees and shared resources, driving groundbreaking research and solutions for global issues. Despite their potential, GUNs face hurdles such as technological disparities, administrative complexities, and the need for equitable partnerships. Future success hinges on embracing hybrid learning, digital credentials, and skills-based education aligned with the United Nations' Sustainable Development Goals (SDGs). By developing robust digital platforms and fostering inclusive, bottom-up relationships, GUNs can effectively leverage their strengths. Case studies, including the Association of Pacific Rim Universities and Universitas 21, demonstrated their tangible impact in advancing academic excellence and social responsibility. Strengthening these networks requires an ongoing commitment to inclusivity and alignment with global development objectives.

Keywords: Collaboration; Partnership; Digital credential; Skills-based education; Solution

Introduction

In an era defined by rapid globalisation, unprecedented technological advancements, and a growing array of complex, interconnected global challenges, the traditional role and operational model of higher education institutions are undergoing a profound transformation (Rehman, 2025). Universities, once primarily seen as localised centers of learning and research, are increasingly recognising that isolation is no longer a viable or effective strategy for progress. The pressing issues of the 21st century, ranging from

climate change and global pandemics to economic inequalities and technological disruption, demand a collective, interdisciplinary, and international response that no single institution can adequately provide on its own. This paradigm shift has given rise to the strategic imperative of Global University Networks (GUNs), which are emerging as pivotal mechanisms for fostering deeper international collaboration, facilitating resource sharing, and amplifying the collective impact of higher education worldwide (Annapareddy, 2025).

The concept of university collaboration is not new, but the scope, scale, and strategic intent behind contemporary GUNs represent a significant evolution. These networks move beyond traditional bilateral partnerships to create multifaceted, often multi-continental, alliances designed to achieve shared objectives that transcend individual institutional capabilities. They are born from the recognition that pooling intellectual capital, diverse perspectives, and specialised resources across geographical and cultural boundaries can unlock innovative solutions, enrich educational experiences, and accelerate research breakthroughs at a pace unachievable through solitary efforts. The very fabric of global society is now interwoven with intricate supply chains, digital communications, and shared cultural narratives, making it incumbent upon educational institutions to mirror and actively shape this interconnected reality (Rådberg & Löfsten, 2024).

The core motivation behind the proliferation of GUNs is the pursuit of collective impact, the idea that multiple organizations working together on a common agenda, with shared measurement, continuous communication, and mutually reinforcing activities, can achieve significant and lasting social change. Within the context of higher education, this translates into a powerful synergy where universities collaboratively address global grand challenges, enhance the quality and relevance of education, foster a globally competent workforce, and promote cultural understanding. Whether tackling sustainable development goals, advancing cutting-edge scientific research, or developing innovative pedagogical approaches, GUNs provide the infrastructure and framework for concerted action (Jones et al., 2021).

This study examined the multifaceted dimensions of Global University Networks, establishing their critical role in an increasingly complex world. It explored how these networks function as platforms for enriching educational

curricula through diverse global perspectives, facilitating large-scale collaborative research initiatives that tackle urgent societal problems, and enhancing graduate employability by instilling essential cross-cultural competencies and adaptive skills (Chowdhury & Alzarrad, 2025). Furthermore, it examined how GUNs serve as vital conduits for cultural exchange and global networking, building crucial interpersonal and institutional connections that underpin future collaborations. By examining the transformative potential inherent in these strategic alliances, this study aimed to underscore why Global University Networks are not merely an optional add-on but an indispensable component of a resilient, responsive, and impactful higher education landscape in the 21st century. Their continued growth and evolution are essential for shaping a future where education actively drives progress, fosters global citizenship, and collectively addresses humanity's most pressing concerns (Tuba, 2023). Some of the available GUNs are presented in Table 1.

Characteristics of Global University Networks

Global University Networks (GUNs) are dynamic and evolving entities, characterised by several key features that distinguish them from traditional bilateral university partnerships. These characteristics enable them to achieve a greater collective impact in the complex global landscape of higher education:

a) Multilateral and Diverse Membership: Unlike simple bilateral agreements, GUNs typically involve three or more or sometimes hundreds of institutions from various countries and regions. This diversity in membership brings a rich array of academic strengths, cultural perspectives, and research specialisations, fostering a more comprehensive approach to global challenges. Members can range from large research-intensive universities to smaller specialised institutions (Acac, 2024).

b) Shared Vision and Strategic Alignment: Effective GUNs are built upon a common strategic vision and shared objectives. Members align their institutional goals with the network's overarching mission, which often revolves around specific themes such as sustainable development, global health, digital transformation, or fostering global citizenship. This alignment ensures that collaborative efforts are

purposeful and directed towards significant collective outcomes (Bowser et al., 2024).

c) Collaborative Programmes and Initiatives: The core of GUNs lies in their active collaborative programmes (Rehman, 2025). These can include:

   i. Joint Research Projects: Pooling expertise and resources to conduct interdisciplinary research on global issues.

   ii. Student Mobility and Exchange: Facilitating opportunities for students to study abroad, gain international experience, and earn credits or joint/dual degrees.

   iii. Faculty Mobility and Collaboration: Enabling faculty to teach, research, and collaborate across institutions, sharing best practices and developing joint curricula.

   iv. Shared Curricula and Joint Degree Programmes: Developing common academic programmes or offering degrees jointly, enhancing the global relevance and appeal of qualifications.

   v. Resource Sharing: Accessing specialised facilities, libraries, digital resources, and expertise across the network.

   vi. Capacity Building: Supporting less resourced institutions within the network through knowledge transfer, training, and infrastructure development.

d) Flexible Governance and Operational Structures: GUNs adopt various governance models, ranging from loosely affiliated consortia to more formally structured entities with dedicated secretariats and clear decision-making processes. Flexibility is key to accommodating the diverse legal, administrative, and academic frameworks of member institutions. Effective governance ensures accountability, transparency, and the efficient allocation of resources.

e) Leveraging Technology for Connectivity: Digital technologies are fundamental enablers for GUNs. They facilitate virtual collaboration, remote learning, shared digital platforms for course delivery, data exchange, and seamless communication across time zones. This characteristic has become even more pronounced with the rise of

hybrid and virtual learning models, making geographical distance less of a barrier.

f) Focus on Global Relevance and Impact: A defining characteristic is their commitment to addressing issues of global significance. GUNs aim to contribute tangibly to societal progress, whether through research influencing policy, developing innovative solutions, or educating graduates equipped to navigate and contribute to a globalised world. Many align their efforts with frameworks like the UN Sustainable Development Goals (SDGs).

Voluntary Participation and Mutual Benefit: Membership in GUNs is typically voluntary, driven by the perceived mutual benefits for participating institutions. These benefits can include enhanced reputation, increased student and faculty recruitment, access to funding.

Table 1: Some Global University Networks

Network Name	Primary Focus / Mission	Key Characteristics	Examples of Member Universities (Illustrative)
Universitas 21 (U21)	Fostering global collaboration for research, education, and innovation.	Research-intensive, diverse global membership, focus on student experience and future leaders.	University of British Columbia, University of Glasgow, National University of Singapore, University of Melbourne
Worldwide Universities Network (WUN)	Addressing global challenges through international research collaboration and education.	Strong emphasis on interdisciplinary research programs, global policy impact.	University of Leeds, University of Wisconsin-Madison, University of Sydney, Zhejiang University
International Alliance of Research Universities	Promoting research collaboration and education among leading research-	Highly selective, focus on shared research infrastructure and	University of Cambridge, Yale University, Peking University, Australian

(IARU)	intensive universities.	student mobility.	National University
Matariki Network of Universities (MNU)	Enhancing diversity, sharing ideas, and learning best practices among research-intensive universities with a commitment to a broad-based education.	Emphasizes a "rounded education" and excellence in scholarship.	Dartmouth College, Durham University, Queen's University (Canada), University of Western Australia
McDonnell International Scholars Academy	Connecting leading global universities through faculty and student exchange to address global challenges.	Focus on graduate student exchange and research collaboration, particularly with Washington University in St. Louis as the hub.	Washington University in St. Louis, Fudan University, Hebrew University of Jerusalem, Indian Institute of Technology Bombay
Global Network for Advanced Management (GNAM)	Connecting leading business schools worldwide to foster global understanding and innovation in management education.	Primarily focused on business education, student and faculty exchanges, global case studies, and dual degrees.	Yale School of Management, National University of Singapore Business School, IE Business School, University of Ghana Business School
Association of Pacific Rim Universities (APRU)	Connecting leading research universities of the Asia-Pacific region to address common challenges and	While geographically focused, its impact and membership from a vast region give it global significance. Focus on research, education, and	University of California, Berkeley; Peking University; University of Tokyo; Australian National University

	opportunities.	policy advocacy.	
Consortium of Universities for Global Health (CUGH)	Supporting academic institutions and partners to improve the wellbeing of people and the planet through education, research, service, and advocacy in global health.	Specific focus on global health, diverse membership including medical schools and public health programs.	Universities globally with strong global health initiatives.
Open Society University Network (OSUN)	Integrating learning and knowledge to address global challenges, focusing on open societies, human rights, and social justice.	Emphasis on interdisciplinary teaching, research, and public engagement, particularly in challenging contexts.	Central European University, Bard College, American University of Central Asia

Core Objectives of Global University Networks

Global University Networks (GUNs) are not merely collections of universities; they are strategically formed alliances driven by specific, interconnected objectives designed to leverage collective strengths for greater impact in the global higher education landscape (Deredzai & Goronga, 2025). While the precise aims might vary slightly between networks depending on their focus (e.g., research-intensive, specific disciplines, or regional impact), several core objectives are common across most prominent GUNs:

a. Enhance Academic Excellence and Quality:

   i. Elevate Teaching and Learning: By sharing best practices, innovative pedagogies, and diverse curricula, GUNs aim to enrich the educational experience for students. This includes facilitating joint degree programmes, credit transfers, and

blended learning initiatives that expose students to varied academic traditions and global perspectives.

ii. Promote Cutting-Edge Research: A primary objective is to foster interdisciplinary and international collaborative research. By pooling expertise, resources, and infrastructure, GUNs enable members to tackle complex global challenges that require multidisciplinary approaches, leading to groundbreaking discoveries and solutions.

iii. Facilitate Knowledge Exchange: Networks provide platforms for faculty, researchers, and students to exchange ideas, methodologies, and findings, accelerating the dissemination of knowledge and fostering a global intellectual community.

b. Foster Global Citizenship and Competency:

i. Develop Globally Minded Graduates: GUNs strive to cultivate graduates who possess not only specialised knowledge but also strong intercultural communication skills, adaptability, and a deep understanding of global issues. This is often achieved through student mobility programmes, collaborative virtual projects, and curricula with a global focus.

ii. Promote Cultural Understanding: By facilitating interaction among students and faculty from diverse backgrounds, GUNs break down cultural barriers, fostering empathy, tolerance, and mutual respect crucial for navigating an interconnected world.

c. Address Global Challenges and Societal Needs:

i. Contribute to Sustainable Development: Many GUNs explicitly align their activities with the United Nations Sustainable Development Goals (SDGs), focusing research, education, and outreach on areas like climate action, global health, poverty reduction, and sustainable cities.

ii. Inform Policy and Practice: By generating robust, evidence-based research and fostering expert dialogue, GUNs aim to influence national and international policy-making and contribute to practical solutions for societal problems.

d. Strengthen Institutional Capacity and Internationalisation:
    i. Build Institutional Capabilities: GUNs can help member universities enhance their own internationalisation strategies, improve administrative efficiency in global partnerships, and develop expertise in managing complex cross-border collaborations.
    ii. Increase Global Visibility and Reputation: Membership in a prestigious GUN can significantly raise a university's international profile, attracting top talent (students and faculty) and opening doors to new funding opportunities and strategic partnerships.
    iii. Leverage Collective Resources: By sharing administrative burdens, negotiating power, and access to specialised facilities, GUNs allow member institutions to achieve economies of scale and pursue ambitions that might be beyond the scope of a single university.
e. Cultivate Future Leaders and Talent:
    i. Nurture Leadership Skills: Many networks include programmes specifically designed to develop leadership capabilities among students, faculty, and administrators, equipping them to lead in a global context.
    ii. Support Early Career Researchers: Providing opportunities for mentorship, networking, and collaborative research for postgraduate students and early career academics is often a key objective, ensuring a pipeline of future global talent.

Key benefits of participation

Participation in Global University Networks (GUNs) offers a multitude of key benefits for member institutions, extending beyond individual academic and research pursuits to encompass broader strategic advantages and societal impact (Marginson, 2022). These benefits reinforce the rationale for universities to engage in such complex, multilateralliances:

1. Enhanced Global Reputation and Visibility: Joining a prestigious GUN significantly elevates an institution's international standing and

visibility. It signals a commitment to global engagement, academic excellence, and collaborative innovation, which can attract top-tier students, faculty, and research funding. This improved reputation can also positively influence international university rankings.

2. Access to Diverse Expertise and Resources: GUNs provide unparalleled access to a vast pool of specialised knowledge, research infrastructure, and diverse academic perspectives from around the world. This allows institutions to tap into expertise they might lack internally, fostering interdisciplinary breakthroughs and enriching both teaching and research endeavors. Members can share access to unique laboratories, specialized databases, and even rare collections.
3. Expanded Research Opportunities and Impact: Collaboration within GUNs enables larger, more ambitious research projects that address complex global challenges (e.g., climate change, global health, food security). By pooling resources and expertise, universities can undertake studies that would be impossible for single institutions, leading to more impactful discoveries and a greater contribution to solving pressing societal problems.
4. Enriched Educational Experience for Students: Students benefit immensely through:
    a. Mobility Programmes: Opportunities for international exchange, study abroad, and joint/dual degree programs broaden their academic horizons, expose them to different teaching styles, and foster cultural competency.
    b. Globally Relevant Curricula: Access to diverse course offerings and instructors from partner institutions, often leading to more globally focused and interdisciplinary learning experiences.
    c. Enhanced Employability: Graduates gain a competitive edge in the global job market due to their international experience, intercultural skills, and expanded professional networks.
5. Professional Development for Faculty and Staff: Faculty members gain opportunities for international collaboration, co-authorship of research, access to new methodologies, and professional networking.

Staff can also benefit from sharing best practices in international education administration, technology, and university management.

6. Increased Funding and Strategic Partnerships: Membership in a GUN can open doors to new funding sources, including international grants and philanthropic initiatives that specifically target collaborative global projects. These networks can also serve as platforms for forging other strategic partnerships with industry, governments, and Non-Government Organisations (NGOs) on a global scale.
7. Capacity Building and Knowledge Transfer: For institutions in developing regions or those aiming to strengthen specific areas, GUNs offer invaluable opportunities for capacity building through mentorship, training programmes, and knowledge transfer from more established partners, helping to raise overall standards and reduce disparities.
8. Influence on Global Policy and Advocacy: By presenting a united front, GUNs can collectively advocate for higher education's role in global policy discussions, influencing international agendas on issues such research funding, educational standards, and sustainable development.

Challenges faced by GUNs

While Global University Networks (GUNs) offer immense benefits, their formation and effective operation are fraught with significant challenges that require careful navigation. These obstacles often stem from the inherent complexities of bringing together diverse institutions across varied geopolitical, economic, and academic landscapes (Knoth et al., 2023).

Here are some of the key challenges faced by Global University Networks:

1. Administrative and Bureaucratic Hurdles:
    a. Differing Academic Calendars and Structures: Reconciling varying academic years, semester systems, credit transfer mechanisms, and grading standards across institutions can be a major logistical challenge or student and faculty mobility, as well as joint programme development.

b. Legal and Regulatory Discrepancies: Navigating diverse national laws, accreditation requirements, intellectual property rights, data privacy regulations (e.g., GDPR), and visa policies can be complex, time-consuming, and costly.

c. Institutional Autonomy vs. Network Alignment: Universities value their autonomy, and convincing them to align their internal strategies, resource allocation, and decision-making processes with network-wide goals can be a delicate balancing act.

2. Technological Disparities and Infrastructure Limitations:

   a. Unequal Access to Technology: Not all member institutions, especially those in developing regions, have access to robust internet infrastructure, up-to-date software, or reliable power supply. This digital divide can hinder seamless virtual collaboration, online learning initiatives, and data sharing.

   b. Interoperability Issues: Integrating different learning management systems (LMS), research platforms, and administrative software across institutions can be technically challenging and require significant investment.

   c. Cybersecurity Concerns: Sharing sensitive data and operating interconnected systems expose the network to various cyber threats. Protecting intellectual property, student records, and research data across multiple jurisdictions with varying security protocols is a significant challenge.

3. Financial Constraints and Sustainability:

   a. Funding Models: Securing sustainable funding for network-wide activities, administrative overheads, and joint projects can be difficult, as traditional national funding mechanisms often prioritize domestic initiatives.

   b. Cost Sharing: Ensuring equitable contributions and managing financial flows across different countries with varying economic capacities can lead to tensions.

c. Return on Investment (ROI) Justification: Demonstrating clear and measurable benefits to secure continued institutional commitment and investment can be challenging, particularly in the short term.

4. Cultural and Communication Barriers:

   a. Language Differences: While English often serves as a lingua franca, nuances can be lost, and significant portions of the academic community may not be fully proficient, leading to communication breakdowns.

   b. Varying Academic Cultures: Differences in pedagogical approaches, research ethics, hierarchical structures, and communication styles can lead to misunderstandings and friction.

   c. Time Zone Management: Coordinating meetings, virtual classes, and collaborative projects across multiple time zones can be logistically challenging and lead to participant fatigue.

5. Equitable Partnership and Power Imbalances:

   a. "Donor-Recipient" Dynamics: Networks involving institutions from highly resourced and less resourced countries can inadvertently perpetuate power imbalances if not carefully managed, potentially leading to an unequal distribution of benefits or decision-making influence.

   b. Recognition and Value: Ensuring that the contributions of all partners, regardless of their size or perceived prestige, are equally valued and recognized is crucial for maintaining genuine collaboration and preventing resentment.

   c. "Brain Drain" Concerns: Some partnerships might inadvertently lead to a "brain drain" if students or faculty from less developed institutions are not adequately supported to return and contribute to their home institutions after international experiences.

6. Lack of Faculty Buy-in and Readiness:

a. Resistance to Change: Faculty members may be hesitant to adopt new collaborative tools, pedagogical approaches, or interdisciplinary methods required for network participation.

b. Workload and Incentives: International collaboration often adds to faculty workload, and insufficient recognition or incentives can limit participation.

c. Training Needs: Faculty may require training in cross-cultural communication, virtual teaching, and collaborative research methodologies.

Strategies for Strengthening Collective Impact

To strengthen the collective impact of Global University Networks (GUNs) and maximize their potential, a series of strategic approaches are essential. These strategies aim to mitigate the challenges faced and amplify the inherent benefits of international academic collaboration (Reed et al., 2022).

Here are key strategies for strengthening collective impact in GUNs:

1. Develop a Clear, Shared Vision and Measurable Goals:

    a. Common Agenda: All participating institutions must commit to a clearly articulated, shared vision of their purpose and a common understanding of the global problems they aim to address. This "common agenda" acts as the guiding star for all network activities.

    b. Shared Measurement: Define specific, measurable, achievable, relevant, and time-bound (SMART) goals and agree on common metrics to track progress. This ensures accountability, allows for continuous learning, and demonstrates tangible impact to all stakeholders and potential funders.

    c. Focus on Systemic Change: Encourage initiatives that aim for systemic change rather than isolated programs. This involves strategies that improve communication across organizations, shift norms, and enhance services system-wide.

2. Foster Robust Governance and Leadership:

a. Flexible and Adaptive Governance: Adopt governance models that are flexible enough to accommodate diverse institutional contexts, yet strong enough to ensure clear decision-making, resource allocation, and accountability. This might involve a dedicated backbone support team or secretariat.

b. Strong Leadership and Champions: Identify and empower visionary leaders within member institutions who can champion the network's mission, secure institutional buy-in, and navigate complex negotiations.

c. Transparent Communication Channels: Establish frequent, structured, and open communication across all levels of the network to build trust, ensure mutual understanding, and maintain common motivation among partners.

3. Invest in Digital Infrastructure and Connectivity:

a. Bridging the Digital Divide: Actively work to address technological disparities among member institutions by facilitating access to reliable internet, shared digital platforms, and necessary software. This might involve joint grant applications for infrastructure development.

b. Interoperable Systems: Prioritise the development or adoption of interoperable digital systems for data exchange, virtual collaboration tools, and online learning platforms to ensure seamless integration and communication.

c. Cybersecurity Protocols: Implement robust and harmonised cybersecurity measures across the network to protect sensitive data, research findings, and intellectual property, building trust among collaborating partners.

4. Promote Equitable and Inclusive Partnerships:

a. Bottom-up Engagement: Encourage organic, bottom-up collaborations initiated by faculty and researchers, alongside top-down strategic directives, to ensure relevance and sustainability.

b. Mutual Benefit and Reciprocity: Design partnerships that ensure clear, reciprocal benefits for all members, regardless of their size, reputation, or economic standing. Actively work to prevent "donor-recipient" dynamics and promote genuine co-creation.

c. Diversity and Inclusion: Actively promote diversity in membership, ensuring representation from various geographic regions, institutional types, and academic disciplines. Foster an inclusive culture where all voices are heard and valued.

5. Cultivate Trust and Shared Culture:

   a. Relationship Building: Invest in opportunities for in-person meetings, workshops, and informal interactions to build strong interpersonal relationships and foster a sense of community among faculty, staff, and students across the network.

   b. Cultural Sensitivity Training: Offer training and resources to help members understand and navigate different academic and national cultures, promoting effective cross-cultural communication and collaboration.

   c. Celebrate Successes: Regularly recognise and celebrate the achievements of the network and its individual members to reinforce positive relationships and maintain momentum.

6. Diversify Funding and Ensure Sustainability:

   a. Innovative Funding Models: Explore diverse funding sources beyond traditional institutional contributions, including joint applications for international grants, philanthropic support, and partnerships with industry or government agencies.

   b. Demonstrate Value Proposition: Continuously articulate and demonstrate the tangible value and Return on Investment (ROI) of network participation to secure long-term institutional commitment and external funding.

Future of Global University Networks

The future of Global University Networks (GUNs) is poised for significant evolution, driven by accelerating technological advancements, shifting global

priorities, and the ongoing demand for more accessible, relevant, and impactful higher education. These networks will likely become even more central to the academic landscape, adapting and innovating to address the complexities of a rapidly changing world.

Here are key trends and characteristics that will define the future of GUNs:

1. Hyper-Digitalization and Hybrid Models as the Norm (Li & Zhang, 2021):
    a. Seamless Virtual Collaboration: Expect a deeper integration of advanced digital platforms, Virtual Reality (VR), and Augmented Reality (AR) to create truly immersive and interactive collaborative learning and research environments. Virtual labs, global online classrooms, and digital conferencing will become even more sophisticated and commonplace, reducing geographical barriers.
    b. AI-Powered Personalisation: Artificial Intelligence will play a transformative role. AI-driven platforms will offer highly personalised learning pathways, adaptive assessments, and intelligent tutoring systems, tailoring education to individual student needs and learning styles across diverse cultural contexts. AI will also streamline administrative tasks, student support, and data analytics for network-wide efficiency.
    c. Digital Credentials and Micro-credentials: The future will see a rise in globally recognised digital credentials and micro-credentials. GUNs will be at the forefront of developing and validating these, allowing students to gain specialised skills and competencies from various network institutions, making qualifications more flexible, accessible, and responsive to industry demands.
2. Increased Focus on Grand Challenges and Interdisciplinary Solutions (Petersen et al., 2022):
    a. SDG-Aligned Research and Education: GUNs will intensify their focus on the United Nations Sustainable Development Goals (SDGs). Collaborative research will be increasingly driven by the need to find global solutions to climate change,

pandemics, poverty, and inequality, fostering deep interdisciplinary work across network members.

b. Impact-Driven Engagement: There will be a greater emphasis on demonstrating tangible societal impact. GUNs will move beyond mere academic outputs to actively engage with policymakers, industries, and communities worldwide to translate research into real-world applications and policy recommendations.

3. Evolving Pedagogy and Skills for the Future Workforce (Michel & Traifeh, 2024):

    a. Skills-Based and Experiential Learning: Education within GUNs will become even more focused on developing critical 21st-century skills like critical thinking, problem-solving, creativity, collaboration, and digital literacy. This will involve more project-based learning, simulations, and real-world experiences, often co-created with industry partners within the network.

    b. Lifelong Learning Ecosystems: GUNs will expand their offerings beyond traditional degree programmes to include continuous professional development and up-skilling opportunities for a diverse global workforce, catering to the need for lifelong learning in a dynamic job market.

4. Strengthened Governance, Equity, and Inclusivity (Kaur & Tham, 2022):

    a. Sophisticated Governance Models: As networks grow in complexity, governance structures will need to become more sophisticated, agile, and equitable. This includes mechanisms for fair resource allocation, shared decision-making and robust conflict resolution among diverse partners.

    b. Addressing Power Imbalances: A critical area of focus will be ensuring genuine equity in partnerships, actively working to prevent "brain drain" and ensuring that institutions from all socio-economic contexts derive mutual benefit and have an equal voice.

c. Localized Global Relevance: While globally connected, GUNs will increasingly emphasize how global knowledge can be adapted and applied to local contexts, respecting diverse cultural norms and local needs.

5. New Funding Models and Industry Integration (Carayannis & Morawska-Jancelewicz, 2022):

    a. Diversified Revenue Streams: GUNs will explore more innovative and diversified funding models, moving beyond traditional government grants and tuition fees. This will include increased philanthropic support, corporate sponsorships for collaborative research, and revenue from joint intellectual property.

    b. Deeper Industry Partnerships: Expect more embedded partnerships with multinational corporations, NGOs, and governmental agencies, leading to co-designed curricula, applied research projects, and direct pathways for student employment within global industries.

Conclusion

Global University Networks (GUNs) have unequivocally emerged as indispensable actors in the 21st-century higher education landscape. Moving beyond traditional bilateral exchanges, these multifaceted alliances leverage collective strengths to tackle grand global challenges, foster academic excellence, and cultivate globally competent citizens. Their core objectives – from enhancing research and teaching quality to promoting cultural understanding and contributing to sustainable development – underscore their vital role in a world demanding collaborative solutions. Despite the inherent complexities and challenges, such as navigating administrative hurdles, bridging technological divides, and ensuring equitable partnerships, the strategic importance of GUNs continues to grow. By prioritising clear shared visions, robust governance, advanced digital infrastructure, and truly inclusive collaboration, these networks can overcome obstacles and amplify their impact.

Looking ahead, the future of GUNs is one of increasing sophistication and integration. They will be characterised by hyper-digitalisation, AI-powered

solutions, and an even sharper focus on interdisciplinary, impact-driven research, aligned with global development goals. As education continues to evolve towards skills-based and lifelong learning models, GUNs will be pivotal in shaping adaptive curricula and fostering global talent. Ultimately, by continually adapting to new realities and deepening their commitment to shared purpose and equity, Global University Networks are poised to remain at the forefront of driving progress, fostering global citizenship, and collectively addressing humanity's most pressing concerns.

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CHAPTER TWENTY-ONE

Globalising Education on Neuropsychiatric Effects of Antibiotics

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Abstract

Antibiotics are well known for fighting infections, but what is often left out of the discussion is their impact on mental health. Their misuse - and even prescribed use - can disrupt the balance of gut bacteria, which plays an important role in how the brain functions. This disruption may cause neurotransmitter imbalances, subsequently leading to several neuropsychiatric disorders. As the world becomes more connected, it is important for healthcare workers to understand these effects. Improving education and encouraging global collaboration will help ensure antibiotics are used more wisely, support mental well-being, and allow exploration of safer alternative ways to treat infections.

Keywords: Globalising Education, Neuropsychiatric, Effects, Antibiotics.

Introduction

Antibiotics are widely recognised for their critical role in combating bacterial infections, revolutionising modern medicine by significantly reducing morbidity and mortality. However, the effects of antibiotics extend beyond their primary role in eradicating pathogens. Although antibiotics are developed to target bacteria, they can have unintended effects on the Central Nervous System (CNS), leading to a variety of neuropsychiatric manifestations. The neuropsychiatric effects of antibiotics encompass a wide spectrum of symptoms, ranging from mild cognitive disturbances and mood changes to more severe outcomes such as anxiety, depression and psychosis.

It is currently believed that antibiotic misuse can induce drug resistance and increase the risk of depression because of the disturbance of intestinal flora (Fan *et al.*, 2022). These effects are often transient and reversible, but they can be distressing for patients and challenging for clinicians to manage. Importantly, these adverse effects are not limited to instances of antibiotic

misuse or overuse. They can occur even when antibiotics are administered at standard therapeutic doses. The case report by Iqbal *et al.* (2022) demonstrated that antibiotics such as Trimethoprim-sulfamethoxazole (TMP-SMX) can induce neuropsychiatric effects, including psychosis, even when prescribed appropriately and not misused. This, again, highlights the need for clinicians to be vigilant about the potential CNS effects during treatment.

These effects should be understood for optimising patient care, particularly in vulnerable populations such as the elderly and those with crucial pre-existing neurological or psychiatric conditions.

Emerging Research on Antibiotics' Unintended Mental Health Effects

Nearly all antibiotic agents have been associated with Central Nervous System effects. These effects can be uncommon, but they can be severe (Skelly *et al.*, 2019). A study highlights how antibiotics can influence brain chemistry and behaviour by disrupting the gut microbiome. This disruption has been linked to an increased risk of depression and anxiety (Dinan & Dinan, 2022), suggesting a complex interplay between gut health and mental health. The gut microbiome, which has long been recognised for its role in digestion and immune function, has been found to also play a significant role in brain health through the gut-brain axis.

Gut Microbiome and Its Role in Health

The gut microbiome is a highly complex and dynamic microbial community, encompassing almost 39 trillion microbial cells, which includes bacteria, viruses, fungi that live in and on us (Kumari *et al*., 2022). A healthy gut with diverse microbes is vital for normal brain functions and emotional behaviours (Suganya & Koo, 2020). Gut bacteria break down fibers from food to produce Short Chain Fatty Acids (SCFAs), which help the gut by reducing inflammation, and supporting brain function. Beneficial bacteria, such as Bifidobacteria, produce tryptophan needed to make serotonin, a neurotransmitter that affects mood and sleep. *Lactobacillus* makes Gamma-Aminobutyric Acid (GABA), promoting calmness (Dinan & Dinan, 2022).

Antibiotics' Impact on the Gut Microbiome

Though antibiotics are highly effective against infections, their broad-spectrum action can unintentionally disrupt the delicate balance of the gut

microbiome. Antibiotics disrupt the delicate balance of the gut microbiome through the following ways:

- **Non-Discriminatory Action:** Antibiotics disrupt the gut microbiome by indiscriminately killing beneficial and harmful bacteria (Zimmermann and Curtis, 2019). Unlike targeted therapies, antibiotics often do not differentiate between "good" and "bad" bacteria. This means they can wipe out beneficial bacteria alongside the harmful ones causing the infection.
- **Shifting the Landscape**: The loss of beneficial bacteria disrupts the overall composition of the gut microbiome. In this disrupted state, this gives room for pathogens like *Clostridioides difficile* to overgrow (Ramírez *et al.*, 2020).
- **Reduced Diversity**: Antibiotic use can reduce gut microbiota species diversity and alter metabolic activity leading to recurrent *Clostridioides difficile* infections (Ramírez *et al*., 2020). Reduced diversity can promote dysbiosis (an imbalance within a community of microorganisms living together — a microbiome), as some bacteria may become overly dominant, leading to an imbalance in the production of metabolites.

How Does the Gut Microbiome Communicate with the Brain?

The Gut-Brain Axis

The gut microbiome is comprised of all the microorganisms in the gut including bacteria, viruses, and fungi and the bi-directional communication between the gut and brain mediated via actions of bacteria is referred to as the "microbiota-gut-brain axis" (Olavarría-Ramírez *et al.*, 2023). The gut microbiome communicates with the brain through a complex network of nerves, hormones, and immune messengers. One of the primary neural routes is the vagus nerve, which transmits signals (neurotransmitters) between the gut and the brain (Ashique *et al.*, 2024).

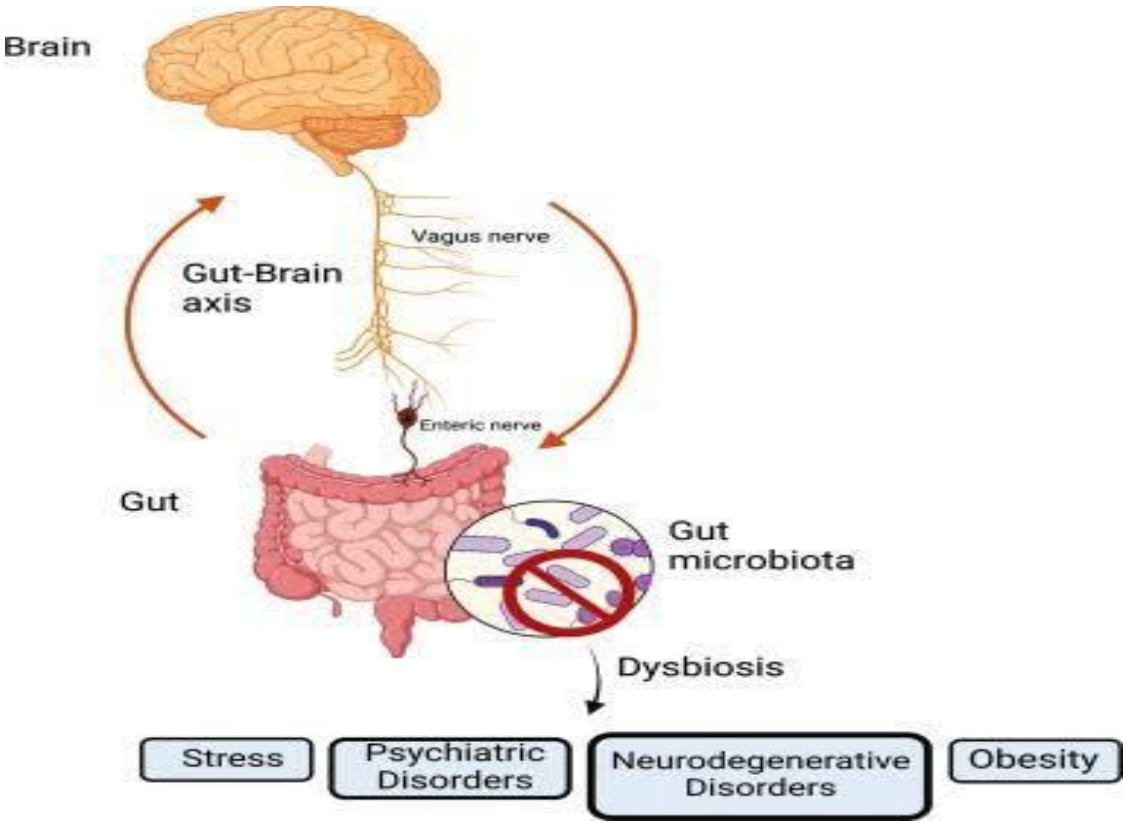


Figure 1: Gut-Brain Axis

Source: (Singh *et al.*, 2024).

Neuropsychiatric Effects Associated With Antibiotics

Anxiety

Anxiety disorders are a group of mental health diagnoses characterised by excessive, persistent, and irrational fear or worry about everyday situations or events. Fluoroquinolones, a class of antibiotics used to treat serious bacterial infections, including respiratory, urinary tract, and skin infections, are associated with psychiatric adverse events such as anxiety (Xie *et al.,* 2024).

Depression

Depression is a common mental disorder with persistent depressed mood and common symptoms like inferiority, pessimism and suicide behaviour (Meng *et al.*, 2022). As a serious mental illness, depression is recognised as a disease associated with the gut microbiota and the brain–gut axis (Wen-Zhi *et al.,*

2020). Dinan and Dinan study in 2022 found that antibiotic exposure is associated with an increased risk of depression. A single course of antibiotics was linked to a higher risk of depression, with penicillins and quinolones. The risk of depression increased with repeated antibiotic use.

Mania

Mania is a mental illness characterised by increased talkativeness, rapid speech, decreased need for sleep, racing thoughts and distractibility (Dailey & Saadabadi, 2023). Meszaros *et al*. (2021) reported a case of antibiotic-induced mania in a 50-year-old man with no prior psychiatric history. The patient initially started treatment with amoxicillin-clavulanic acid for left basal pneumonia and later switched to clarithromycin. Shortly after beginning the antibiotic therapy, the patient developed psychiatric symptoms, including logorrhea (excessive talking), elevated mood, irritability, increased physical activity, and delusions, which were consistent with a manic episode. Upon stopping clarithromycin, the patient's symptoms improved within 12 hours, supporting the diagnosis of a clarithromycin-induced manic episode. However, when amoxicillin-clavulanic acid was reintroduced for the pneumonia, the psychiatric symptoms reappeared. After discontinuing the second antibiotic, the patient was symptom-free approximately one week after. The case highlights the potential for antibiotics such as clarithromycin and amoxicillin-clavulanic acid to induce manic episodes as a rare but serious side effect.

Psychosis

Psychosis is a clinical syndrome associated with impairments in multiple domains including functioning, thought, behaviour, and cognition (Kilciksiz *et al.*, 2020). It is a severe mental disorder characterised by a loss of touch with reality. The most common antibiotics leading to the development of psychosis are penicillin, fluoroquinolones, cephalosporins, Linezolid and anti-tuberculous drugs (Maqsood *et al.*, 2022).

Table 1: Neuropsychiatric Effects Linked to Antibiotic Use

Antibiotic Class	**Neuropsychiatric Effect**	**Reference**
Beta Lactams e.g Penicillin and Cephalosporins	Psychosis,Mania, Depression	**(**Guglielmo, 2021; Meszaros *et al.*, 2021; Lam, 2021; Liu *et al.*, 2022; Maqsood *et al.*, 2022**)**
Macrolides e.g	Mania, Depression	(Lam, 2021; Liu *et al.,* 2022)
Fluoroquinolones e.g	Psychosis, Anxiety, Mania	**(**Guglielmo, 2021; Maqsood *et al.*, 2022; Xie *et al.,* 2024)
Tetracyclines	Depression	
Sulfonamides	Psychosis	(Liu *et al.*, 2022) (Iqbal *et al*., 2022)

Susceptibility Factors

A. Age as a Determinant

Age is a critical factor influencing susceptibility to antibiotic-induced neuropsychiatric effects.

- **Pediatric population**: The developing brain in children is particularly sensitive to external influences. Antibiotic exposure during critical developmental periods may have long-term consequences for brain function and mental health. A study by Slykerman *et al*. (2019) found that children exposed to antibiotics during the first six months of life had significantly lower cognitive and verbal comprehension abilities at

age 11, as well as increased risks of attention-deficit hyperactivity disorder (ADHD), anxiety, and emotional problems after adjusting for confounding factors like breastfeeding.

- **Geriatric population**: Elderly individuals are more likely to experience adverse drug reactions due to age-related physiological changes, including decreased renal and hepatic function, and polypharmacy. The study by Liu *et al*., 2021 suggested that exposure to certain antibiotics, particularly azithromycin, sulfaclozine, tetracyclines, and veterinary antibiotics, may be associated with an increased risk of depression in elderly individuals.
- **Pre-existing Mental Health Conditions**

  Individuals with pre-existing mental health conditions are at heightened risk of experiencing exacerbated symptoms or developing new psychiatric problems after antibiotic use.

Strategies for Mitigating Risks

To mitigate the risks posed by antibiotics on the gut microbiome and the potential neuropsychiatric symptoms that may arise from this disruption, several strategies can be implemented:

Healthcare providers should:

- Administer antibiotics only when necessary.
- Discontinue the offending antibiotic and switch to a safer alternative if neuropsychiatric symptoms arise (Althubyani *et al*., 2024)
- Choose narrow-spectrum antibiotics over broad-spectrum (Avis *et al.,* 2021).

Patients should:

- Take probiotics/prebiotics to restore gut microbiome (Ashique *et al.*, 2024; Yoo *et al.,* 2024).

Prebiotics and probiotics play crucial roles in gut health. Prebiotics are non-digestible fibers that serve as food for beneficial gut bacteria, promoting their growth and activity. Common sources include bananas, onions, garlic, and whole grains. Probiotics, on the other hand, are live microorganisms that provide health benefits when consumed, found in fermented foods like yogurt,

kefir, and sauerkraut. Together, they help maintain a balanced gut microbiota, supporting digestion and overall health. Probiotic supplementation during the perinatal and infant period can restore gut microbiota imbalance, especially with mixtures of *Lactobacillus* and *Bifidobacterium* strains (Navarro-Tapia *et al*., 2020).

Future Prospects

Antibiotic-specific effects: One crucial aspect of future research is to delve deeper into the differential effects of various antibiotic classes on the gut microbiome and neurotransmitter systems i.e development of selective antimicrobials that target harmful bacteria without disrupting the gut microbiome (Avis *et al.*, 2021).

Alternative Antimicrobial Strategies

a. Phage therapy: This involves the use of bacteriophages to fight bacteria (Tamma and Suh, 2021). Phage therapy, the therapeutic use of bacteriophages to combat bacterial infections, is gaining increasing attention as a promising alternative to traditional antibiotics. Bacteriophages are viruses that specifically infect bacteria, offering the potential for high specificity and minimal impact on the microbiome.

b. Host-Directed therapy: Host-directed therapies represent another promising approach to combating bacterial infections while minimising the impact on the microbiome. The goal of host-directed treatments is to strengthen the immune system of the host, and improve the host's capacity to recognise and react to infections (Gholap *et al.*, 2024). Instead of directly killing bacteria, these strategies focus on bolstering the host's immune response, enabling the body to fight off the infection more effectively.

c. Natural products: Natural antimicrobial compounds are the best alternative for controlling bacterial infections and reducing drug resistance due to their lack of severe side effects, low cost of production, and biocompatibility (Nourbakhsh *et al.*, 2021). Exploring plant-derived compounds and other natural products with antimicrobial properties could lead to the discovery of novel agents with minimal side effects. (Nourbakhsh *et al.*, 2021).

Conclusion

Antibiotics are essential for treating bacterial infections, but their unintended effects on the gut microbiome and brain health cannot be ignored. Disrupting beneficial gut bacteria can reduce neurotransmitter production and short-chain fatty acids, potentially leading to mental health issues. Understanding the gut-brain connection allows for better patient care, especially for vulnerable populations like children, the elderly, and individuals with pre-existing conditions. To minimise risks, monitored antibiotic use, probiotic support, and further research are crucial.

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CHAPTER TWENTY-TWO

Influence of Income Replacement on Management of Chronic Diseases among Retirees in Ilorin South Local Government, Kwara State

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Abstract

The study investigated the influence of income replacement on the management of chronic diseases among retirees in Ilorin South local government. Six (6) research questions were raised, and six (6) research hypotheses were formulated. A survey research design was adopted, and the population for the study included all the retirees in Ilorin South Local Government Area of Kwara State. The study adopted stratified and purposive sampling techniques to select Ilorin South from the sixteen (16) local governments in Kwara state. Three (3) wards were selected from the local government using a purposive sampling technique, and two hundred (200) respondents were selected from these wards. The Income Replacement and Chronic Diseases Management Questionnaire and scorecard (IRCDMQ) was the instrument used for data collection. The research questions were analysed using frequencies, percentages, means, and standard deviations. The hypothesis was tested with a t-test and linear regression at a 0.05 level of significance, and data visualisation was done using ggplot, gtsummary, stargazer packages, and LaTeX. The findings revealed most of the respondents were female, aged 65 – 69 years old, earning below ₦81,000-₦150,000, which is equivalent to $120; and the most common disease among the respondents was arthritis. The hypothesis revealed a significant relationship between post-retirement income and retirees' perception of health management ($p<0.05$), indicating that each additional decrease in post-retirement income is associated with a 0.09081 decrease in the chronic disease management score. Although the study revealed no relationship between post-retirement income and the number of reported diseases, likewise, the differences in pre- and post-retirement income do not influence the number of

reported diseases. Therefore, it is concluded that low-income replacement affects the management of chronic diseases. The researchers recommended that senior citizens, who have served the nation for 35 years or more, should be compensated for their sacrifices during their service years.

Keywords: Chronic disease management, Retirement, Retirees, Income replacement.

Introduction

Disease is the abnormal functioning of an organism (Adalberto & Edwin, 2018). It is a state of physical and anatomical abnormality or disorder that affects the normal functionality of an organism/human. (Howard and Bernell (2016) reported that chronic is commonly used when the root cause of a particular disease lasts for more than three months. Therefore, chronic disease is a physical or anatomical abnormality that last one year or more, limiting daily activities and requiring maximum medical attention and management (Sebelius & Thompson, 2019). Morbidity information of a particular population enables continuous evaluation of the effectiveness of a specific healthcare system or the success of the health policy implemented. Poor management of diseases can lead to multimorbidity, which is a condition of multiple diseases (Skou *et al,* 2022). Nigeria has some of the lowest quality health care in Africa and the world at large as the healthcare system is underdeveloped and lacks modern health equipment and facilities. These challenges have been attributed to poor infrastructure, low government budget, poor staff welfare, and high emigration of healthcare workers (International Trade Administration, 2023).

The income of workers implies the totality of benefits that are given to employees by the employer. This can be salaries, wages, bonuses, and allowances among others for the service offered (Hagedorn, 2023). The income replacement ratio is the percentage of preretirement income received during retirement by an elderly retired person (Schmied, 2023). It is a scheduled amount given to retiree (older person) by the employer during their retirement period, which is the percentage of income received during the pre-retirement period. In most countries, it implies the major monetary benefits received by an employee at the end of a working career. Income replacement is an important criterion embedded under the pension scheme as it ensures the retiree's continuous source of income after disengagement from service.

Retirees, who earn lower income during their pre-retirement days, need a higher replacement during their retirement period as they spend much of their income on food, housing, transportation, and medical care. However, retirees in some states in Nigeria earn as low as ₦500 (30 cents) as monthly pensions. In Kwara state, some retirees earn as low as ₦3000 ($2) monthly (Purcell, 2012, Obiowo, 2024)

Retirement is the stage of total withdrawal from labour force (Dwyer & Hu, 2000). It is accompanied by a reduction in the physiological and psychological commitment of workers (Wang, 2013, Wang & Shi, 2014; Wang & Shultz, 2010). It is a later career development stage in life during which adults continue to grow to pursue different interests. The different types of retirement include phased retirement, deferred retirement, disability retirement, early retirement, and voluntary retirement. This study focused on voluntary retirement. Voluntary retirement is the most common type of retirement and it is primarily based on age or number of years of service. Retirees are paid a lump sum by the government or the employer upon final exit from service as provided by the Retirement Act of a nation. In Nigeria, the traditional retirement age is 65, (though it moved from 55 years to 60 years before now) (Patrick, 2023). Even though the retirement age also varies for some professional workers, retirement usually takes place in older adulthood. Retirees face numerous health challenges, and this is attributed to the diminishing state of physiological and anatomical function of the human body system at this stage of life (Akintunde *et al*, 2021).

Statement of the Problem

Despite the vulnerability of older retirees to chronic diseases, retirees in Nigeria are saddled with the challenge of low-income replacement and poor health challenges among retirees. The National Union of Pensioners reported that some retirees earn as low as N500 (30 cent) pension monthly. Thus, it is observed that lower income among the retirees poses a challenge for managing chronic health conditions. Therefore, this study sought to evaluate the influence of retiree's income replacement on the management of chronic diseases among retirees in Ilorin South Local Government

Objectives of the Study

The study's main objective was to evaluate the influence of income replacement on chronic disease management morbidity management among

retirees in Ilorin South Local Government Area of Kwara State. The specific objectives of the study were to:

1. describe the socio-demographic characteristics of the respondent;
2. evaluate the differences in pre-retirement and post-retirement income among retirees in Ilorin South Local Government Area of Kwara State;
3. examine the relationship between post-retirement income and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara State;
4. determine the relationship between the number of reported diseases and the intensity of the diseases among retirees in Ilorin South Local Government Area of Kwara State;
5. determine the relationship between post-retirement income and retiree's perception on health management in Ilorin South Local Government Area of Kwara State;
6. evaluate the relationship between pre-retirement and post-retirement income differences and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara; and
7. evaluate the relationship between pre-retirement and post-retirement income differences and the intensity of diseases among retirees in Ilorin South Local Government Area of Kwara State.

Hypothesis

1. There is a significant difference in the pre-retirement and post-retirement income among the retirees in Ilorin South Local Government Area of Kwara State.
2. There is a significant relationship between post-retirement income and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara State.
3. There is a significant relationship between the number of reported diseases and intensity of diseases among retirees in Ilorin South Local Government Area of Kwara State.
4. There is a significant relationship between post-retirement income and retiree's perception on health management among retirees in Ilorin South

Local Government Area of Kwara.

5. There is a significant relationship between pre-retirement and post-retirement income differences and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara State.
6. There is a significant relationship between pre-retirement and post-retirement income differences and intensity of the diseases among retirees in Ilorin South Local Government Area of Kwara State.

Method

The study population comprised elderly persons in the Ilorin South Local Government Area of Kwara State, and the target population consisted of retired elderly persons from age 65 to 85 and above in selected wards of Ilorin South Local Government Area of Kwara State. A stratified and purposive sampling technique were adopted for this study. The first stage involved stratifying the state into 16 local government areas, and the second stage involved purposively selecting the Ilorin South Local Government Area. The third stage involved a homogeneous purposive sampling technique to choose three wards namely Akanbi IV, Akanbi V, and Balogun Fulani I from the eleven wards in the LGA, and the last stage involved the adoption of a snowball purposive sampling technique to select 200 retired elderly persons with the assistance of the chairman of the Ilorin South Retiree Association.

A well-structured questionnaire titled "Income Replacement and Chronic Diseases Management Questionnaire and Score-card (IRCDMQ)" was used to collect data. The researcher developed the questionnaire based on the research objectives and research hypotheses that related to chronic diseases. It was segmented into A, B, and C sections. Section A contained the socio-demographic details of the respondent and was designed based on the respondent's features. Section B part of the questionnaire focused on the management of chronic diseases of the respondent, specifically addressing common chronic conditions that affect retirees, such as heart disease, diabetes, arthritis, hypertension, chronic respiratory disease, cancer, depression, and anxiety. The severity of these conditions was measured using a visual analogue scale (VAS) for pain and the Patient Health Score Card (PHSC-4), which allowed respondents to rate the intensity of their conditions based on symptoms, and interference of the disease with the respondent's daily activities. Section C part of the questionnaire focused on the retirees'

perception of their health management during the pre-retirement and retirement period and this was done using a 4 points Likert scale to measure the perception level of the retirees on their health management based on their pre-retirement and retirement income respectively. The average mean was set at 2.50. By this, a mean rating of an item by the respondents equal to or above 2.50 was taken as agreed while less than 2.50 was taken as disagreed. An expert at the Department of Home Economics and Food Science, University of Ilorin Kwara State, Nigeria, validated the questionnaire.

Data were analysed using descriptive, and inferential statistics such as frequencies and percentages. Hypothesis one was tested using a paired sample t-test, while hypotheses two, three, four, five, and six were tested using a regression-based analysis. All null hypotheses were tested at a 0.05 level of significance, and descriptive, inferential statistics and figures were performed and created with R version 4.4.1, and R studio version 2024.4.2.0. Data visualization was done using base R studio statically application base r, ggplot package, gt summary package, stargazer package and latex.

Results

Table 1: Analysis of demographic characteristics of the respondents

Variables		Frequency	Percent%
Gender	Male	52	26
	Female	148	74
Age (in Years)	65-69	124	62
	70-74	40	20
	75-79	16	8
	80-84	16	8
	85 and above	3	2
Marital Status	Married	181	90
	Single	--	--
	Separated	4	2
	Divorced	6	3

	Widow	9	4
Level of education	Primary Education	5	2
	Secondary Education	35	18
	Bachelor's degree	106	53
	Master's degree	29	15
	PhD	25	12

Source: Field Survey (2024)

Table 1 represents the analysis of the demographic characteristics of the respondents, and the following details were revealed: About (26% (n = 52) of the respondents were male, 74% (n = 148) of the respondents were female; most of the respondents were between age 65 - 69 years old with 62% (n = 124). The marital status of the respondents showed that (about 90% (n = 181) were married. The data of the respondents based on level of education showed that (about 53% (n = 106) had bachelor's degrees. This indicated that a higher number of the respondents were female, most respondents were married, and the majority of the respondents were fresh retirees who were between 65 – 69 years of age.

Table 2: Analysis of Pre-retirement income and retirement income of the retirees

SN	Variable	Income in Naira	Frequency	Percent%
1	Pre-retirement income in (Naira)	Less than ₦50,000	7	4
		₦51,000 - ₦80,000	19	10
		₦81,000- ₦150,000	12	6
		₦151,000- ₦200,000	60	30
		₦201,000- ₦300,000	67	34
		₦301,000- ₦400,000	28	14
		₦401,000 – ₦600,000	7	4

		₦601,000 and Above	--	--
2	Post-retirement Income in (Naira)	Less than ₦50,000	47	24
		₦51,000 - ₦80,000	5	2
		₦81,000- ₦150,000	67	34
		₦151,000- ₦200,000	46	23
		₦201,000- ₦300,000	35	18
		₦301,000- ₦400,000	--	--
		₦401,000 – ₦600,000	--	--
		₦601,000 and Above	--	--

Source: Field Survey (2024)

Table 2 represents the pre-retirement income and retirement income of the respondents. It is based on the pre-retirement income of the respondent majority earning ₦151,000 - ₦200,000,

₦201,000 - ₦300,000 at 30% (n = 60) and 34% (n = 67) and based on the post-retirement income majority earning ₦81,000 - ₦150,000 at 67 (n = 34). This indicates that a majority of the retirees earned below $120 United States dollars monthly during retirement.

Table 3: Analysis of the health condition of the respondents

Arthritis	1	57	29
Hypertension	1	25	13
Arthritis, Hypertension	2	20	10
Depression	1	13	7
Diabetes, Heart disease	2	13	7
Cancer, Anxiety	2	12	6
Hypertension, Arthritis	2	9	5

Chronic respiratory disease	2	9	5
Diabetes	1	8	4
Arthritis, Depression, Hypertension	3	6	3
Diabetes, Anxiety, Hypertension	3	5	3
Depression, Heart disease	2	5	3
Diabetes, Depression	2	4	2
Depression, Arthritis	2	3	2
Cancer, Depression	2	3	2
Arthritis, Cancer	2	1	1
Chronic respiratory disease, Arthritis	2	1	1
Depression, Diabetes	2	1	1
Heart disease	1	1	1
Others	--	3	2
NA	--	1	1

Source: Field Survey (2024)

Table 3 represents the health condition of the respondents and it reveals that (about 29% (n = 57) had arthritis; and the more common multimorbidity combinations were arthritis and hypertension 10% (n = 20). This result indicates that arthritis was the common chronic condition experienced by older retirees in Ilorin South Local Government Area of Kwara State.

Table 4: Analysis of the Intensity of the Health Condition of the respondents

	Intensity of the diseases	
Variable	Frequency	Percent %
Minor	41	20
Moderate	53	26

Major	62	31
Severe	44	22

Source: Field Survey (2024)

Table 4 shows the intensity of the diseases of the respondents, and it reveals that 62 (31%) had major, 53 (26%) had moderate, 44 (22%) had severe, and 41 (20%) had minor state of health condition.

Table 5: Frequency, Percentage, Mean Rating, and Standard Deviation on the retiree's perception on the relationship between health management during pre-retirement and post-retirement income

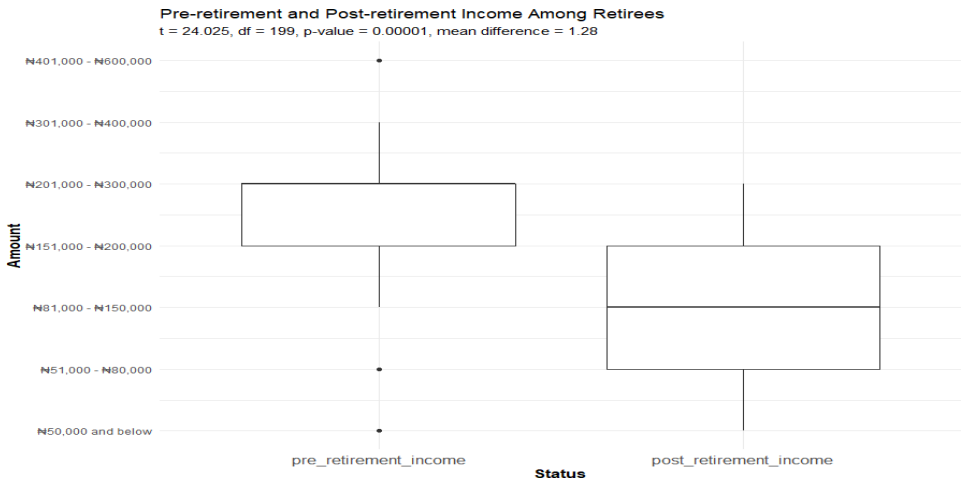
Items	SD f (%)	D f (%)	A f (%)	SA f (%)	Mean $\bar{x}$	Std	Remarks
My financial situation during pre-retirement allows me to effectively manage my health challenge	24 (12)	85 (42)	88 (0)44	03 (02)	2.35	0.71	Disagreed
My financial situation during retirement allows me to effectively manage my health challenge	85 (45)	66 (42)	32 (10)	17 (04)	1.91	0.96	Disagreed

Source: Field Survey (2024) Key SA – Strongly disagreed; D - Disagreed; A Agreed; SA - Strongly agreed; F - Frequency

Table 5 represents the frequency, percentage, mean rating, and standard deviation of the retiree's perception of health management during the pre-retirement and retirement periods. A mean value of 2.35 was obtained for pre-retirement while a mean value of 1.91 was obtained for the retirement income.

The result of the hypothesis

A t-test result on the significant difference between the pre-retirement and post-retirement income among the retirees in Ilorin South Local Government

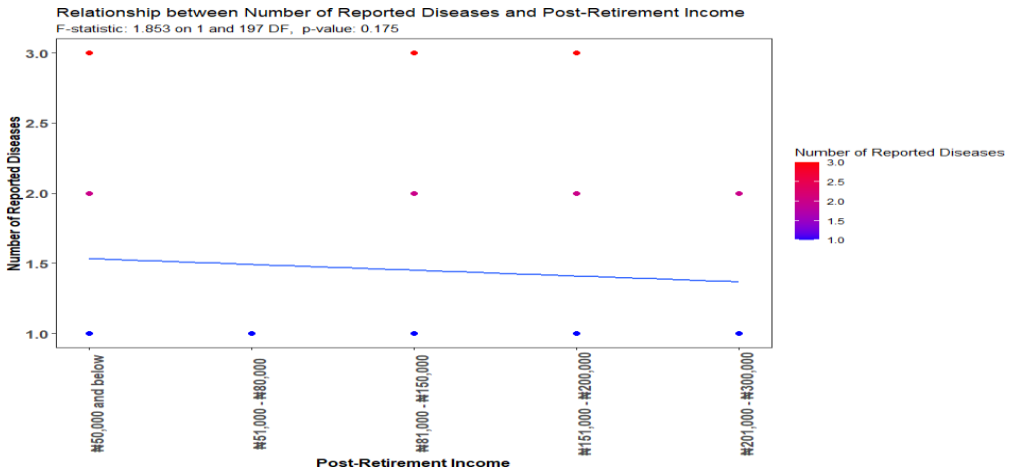


Area of Kwara State

Source: Field Survey (2024)

Figure 1 above reveals the paired t-test analysis to compare the mean of pre-retirement and post-retirement incomes. It shows that a t-value of 24.025 with a degree of freedom of 199, a p-value of 0.00001, and a mean difference of 1.28 was obtained. This indicates a significant difference in pre-retirement and post-retirement incomes of the retirees in Ilorin South Local Government Area of Kwara. Since the p-value of 0.00001 was less than 0.05, with a mean difference of 1.28, it shows that the income replacement is significantly low.

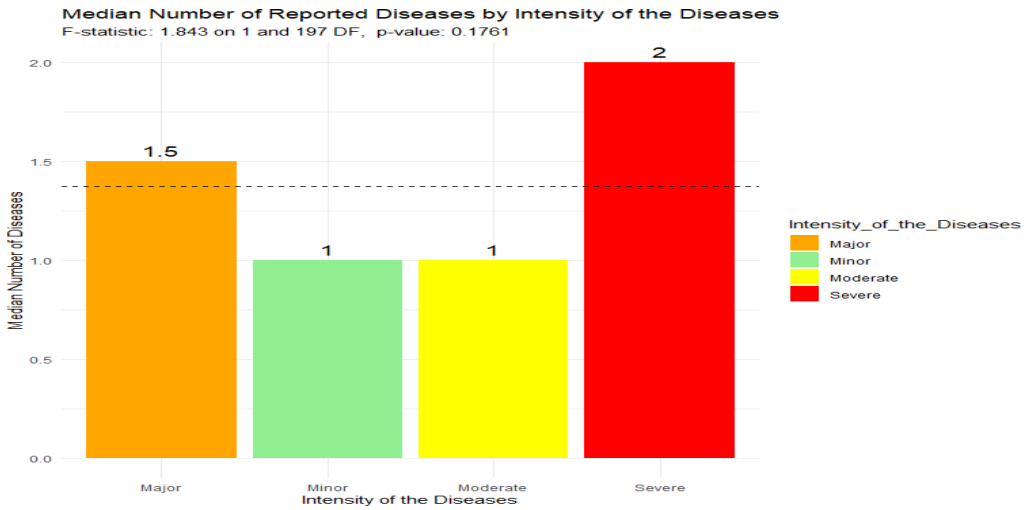
The Relationship between the Post-retirement Income and the Number of Reported Diseases among the Retirees in Ilorin South Local Government Area of Kwara State



Source: Field Survey (2024)

Figure 2 shows the linear regression analysis on the relationship between the post-retirement incomes and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara State. A t-value of -1.36 with a degree of freedom of 197 and a p- value of 0.175 was obtained. This indicates no significant relationship between the retiree's income and the number of reported diseases among retirees in the Ilorin South Local Government Area of Kwara State as the p-value of 0.175 is more than 0.05. Furthermore, the post-retirement income coefficient value of -0.04133 was obtained, and this indicates that for every ₦1 increase in post-retirement income, it will result to a -0.04133 decrease in the number of diseases among retirees.

Relationship between the Number of Reported Diseases and Intensity of Diseases among Retirees in Ilorin South Local Government Area of Kwara State

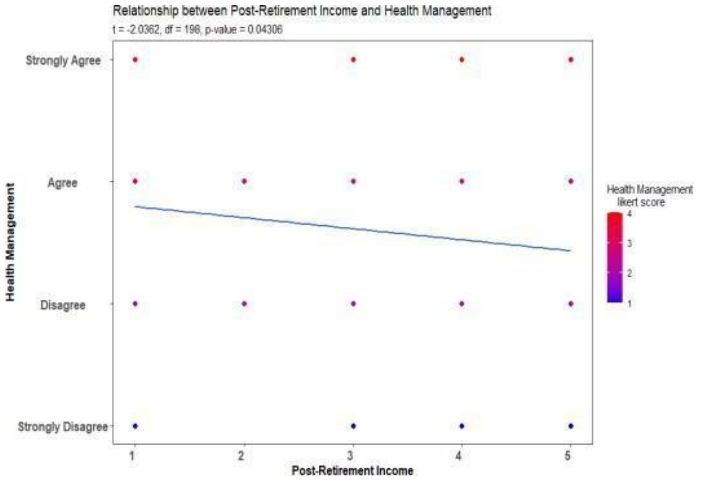


Source: Field Survey (2024)

Figure 3 represents the relationship between the number of reported diseases and intensity among the retirees in Ilorin South Local Government Area of Kwara State. A t-value of

1.358 was obtained with 197 degrees of freedom and a p-value of 0.1761. This indicates no significant relationship between the number of reported diseases and intensity of the diseases among the retirees in Ilorin South Local Government Area of Kwara State, as the p-value of 0.1761 is more than 0.05. The coefficient for the number of reported diseases is 0.171. This suggests that for each additional reported number of diseases, the intensity of the diseases is expected to increase by 0.171.

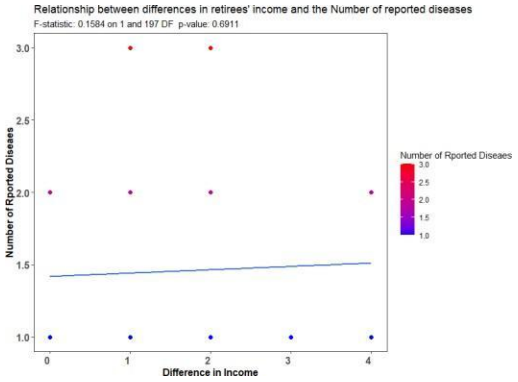
Relationship between the Post-retirement Income and Retiree's Perception on Health Management in Ilorin South Local Government Area of Kwara State



Source: Field Survey (2024)

Figure 4 represents the linear regression on the relationship between post-retirement income and health management among retirees in the Ilorin South Local Government Area of Kwara State. A t-value of -2.0362 was obtained with 198 degrees of freedom and a p-value of 0.04306. This indicates a significant relationship between post-retirement income and health management among retirees in the Ilorin South Local Government Area of Kwara State since the p-value of 0.04306 is less than 0.05. Furthermore, the result revealed that the health management score tends to decrease by 0.09081 for each additional decrease in post-retirement income.

Relationship between Pre-retirement and Post-retirement Income Differences and the Number of Reported Diseases



Source: Field survey 2024

Figure 5 shows the relationship between pre-retirement and post-retirement income differences and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara. It was revealed that a t-value of 0.398, 197 degrees of freedom, and a p-value of 0.6911 were obtained. This indicates no significant relationship between pre-retirement and post-retirement income differences and the number of reported diseases among the retiree since the p-value of 0.6911 was more than 0.05. It revealed that for every one-unit increase in income difference (pre-retirement and post-retirement income), there is a non-significant 0.023 decrease in the number of reported diseases.

Relationship between Pre-retirement and Post-retirement Income Differences and Intensity of the Diseases among Retirees in Ilorin South Local Government Area of Kwara

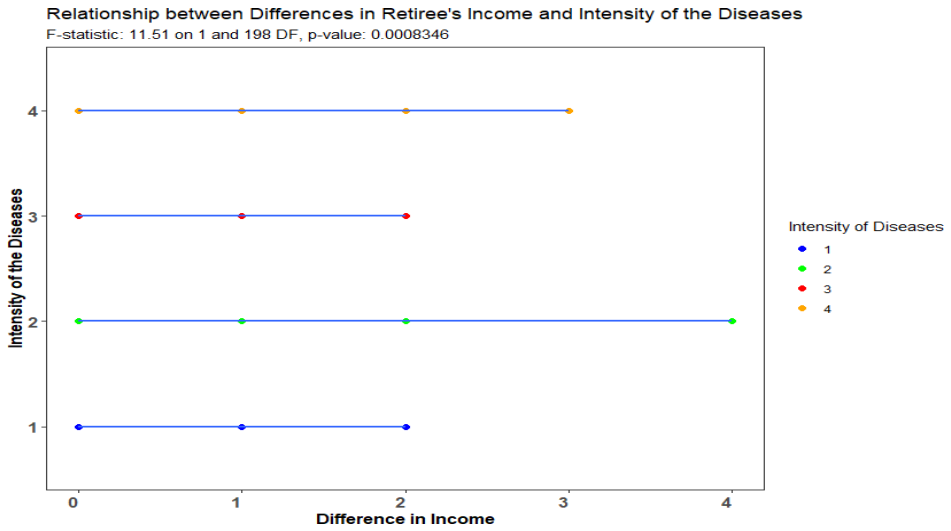


Figure 6 shows the relationship between pre-retirement and post-retirement income differences and the intensity of the diseases among retirees in Ilorin South Local Government Area of Kwara. Fionding revealed that a t-value of 3.393, 198 degrees of freedom, and a p-value of 0.00083 were obtained. This indicates a significant relationship between pre-retirement and post-retirement income differences and the intensity of the diseases among retirees in Ilorin South Local Government Area of Kwara since the p-value of 0.00083 was less than 0.05. Additionally, it was revealed that for every one-unit increase in

income difference (the difference between the pre-retirement and post-retirement income) the intensity of the reported diseases increases by 0.3401 units.

Discussion

The study evaluated the influence of income replacement on chronic disease management among retirees in Ilorin South Local Government Area of Kwars State. Descriptive and inferential statistics were adopted for analysing the data that were collected from the sampled respsondents.

From the socio-demographic characteristic table, the majority of the respondents were female, new cohort, married, and had at least a bachelor's degree qualification.

The analysed data on morbidity and multimorbidity status of the respondents shows that arthritis was the common chronic condition experienced by older retirees in Ilorin South Local Government Area of Kwara State, and the more common multimorbidity combinations were arthritis and hypertension. Anderson and Loeser (2010) reported something similar that increases in age result in osteoarthritis but joint injury increases the intensity.

It was revealed that the financial situation of the respondents in both pre-retirement and post-retirement did not allow proper management of their health. Ugwu and Idemudia (2023) also reported that retirees are often bothered by financial insecurity for their health care management during retirement.

The result of hypothesis 1 revealed a significant difference between the pre-retirement and post-retirement incomes of the retirees with a mean difference of 1.29. This indicates a substantial reduction in the post-retirement income of the retiree. A similar conclusion drawn by Afolabi (2022) was that retirees in Nigeria are experiencing abject poverty, receiving only N4,000-N10,000 ($2-$8) monthly that are unpaid or partly paid, thereby making it difficult for retirees to have proper health management.

The result of hypothesis 2 revealed no relationship between post-retirement income and the number of reported dis eases among the retirees in Ilorin South Local Government Area of Kwara State, and it indicates no connection between low-income earnings among retirees and the level of vulnerability to diseases in older age. Dataphyte (2019) provided contradictory evidence that

revealed the described different findings on the high mortality rate among retirees due to vulnerability to terminal diseases like cancer, and diabetes as a result of low pension income during retirement for proper health management.

The results of hypothesis 3 revealed no significant relationship between the number of reported diseases and the intensity of the diseases among the retirees in Ilorin South Local Government Area of Kwara State. It showed that the number of reported diseases is not connected with the number intensity of the diseases. It was, however, revealed that for each additional reported number of diseases, the intensity of the diseases is expected to increase by 0.171.

The result of hypothesis 4 revealed a relationship between post-retirement income and health management among retirees in the Ilorin South Local Government Area of Kwara State. The result indicated that health management score tends to decrease by 0.09081 for each additional decrease in post-retirement income. Similarly, Ajayi and Ojo (2020) found that a lack of financial stability poses difficulty in retirees' adjustment to health management.

Hypothesis 5 revealed no significant relationship between pre-retirement and post-retirement income differences and the number of reported diseases among retirees. Additionally, for every one-unit increase in income difference (pre-retirement and post-retirement income), there is a non-significant 0.023 increase in the number of reported diseases.

The result of hypothesis 6 revealed a relationship between pre-retirement and post-retirement income differences and the intensity of the diseases among retirees in Ilorin South Local Government Area of Kwara, indicating the influence of income replacement on the well-being of retirees. Gaspar, Rossi, Hone and Dornelles (2021) provided the same evidence that revealed the impact of income inequality and low income on the intensity of diseases.

Conclusion

Based on the findings of this study, it was concluded that low-income replacement (monthly pension) payment of retirees by the government is related to the high susceptibility and management of chronic conditions. Nevertheless, the study revealed no relationship between post-retirement income and the number of reported diseases. Likewise the difference in income does not influence the number of reported diseases. Therefore, the researcher recommended that senior citizens, who had served the nation for 35 years or

more, should be compensated for their sacrifices during service years.

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CHAPTER TWENTY-THREE

Strategies for Promoting Gender Equality in Basic Schools in Nigeria

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Abstract

The discourse on gender equality has increasingly gained traction among education policymakers over the years. This study examined effective strategies for promoting gender equality among basic school pupils in Ibadan metropolis, Oyo state, Nigeria. Descriptive design was employed in this study. The study population consisted of all basic schools in rural communities in Ibadan, Oyo State. A sample of 150 teachers was selected for this study, using probability random sampling techniques. Data gathered in the survey were analysed using percentages, mean, and standard deviation to answer the research questions. The findings revealed a significantly poor perception of gender inequity at the basic school level, with teachers observing high incidences of unequal treatment between boys and girls. Consequently, the study outlined strategies to address these issues, including emphasising education on gender equality, enforcing protective laws, ensuring equal access to leadership roles, and promoting gender-equitable school policies and activities.

Keywords: Gender Equality, Inclusive Education, Education for All, Basic Education.

Introduction

Gender equality is a concept that entails the principle and practice of all individuals having equal access to rights and responsibilities. It can also be described as a situation in which there are no inequalities between males and females in the fulfilment of their rights as human beings. The magnitude and effects of gender awareness have made gender equality highly relevant today, prompting educational centres to prioritise its treatment throughout the school year (Ruiz, 2018). In recognition of this, many organisations and institutions

have adopted essential dates, such as 8th March (International Women's Day) and 25th November (International Day for the Elimination of Violence Against Women), as days of activism and reflection on the movement (Beyene, Chojenta, & Loxton, 2021). Through these foundations, students can learn to reject any form of discrimination and abuse and internalise the values of equality (Abellán, 2014). The Education for All Programme (Al-Jazeera, 2015) has prioritised investing in achieving parity and equality between genders, an idea supported by educational values and the Sustainable Development Goals (Brehim & Boyle, 2018).

Gender equality is Goal number five in the Sustainable Development Goals (SDGs). However, equality should not be treated as merely a democratic principle, but it must be treated as an essential and compulsory goal of educational organisations, schools, public institutions, and institutes (Barrett et al., 2019). Thus, for these values to be effectively transmitted to students, it is essential that teaching be approached carefully in order to ensure absolute equality in the classroom and beyond. Gender equality is an issue of great importance in the formal education system, as equal opportunities for both men and women are essential for achieving parity (Badri, 2015).

Gender equality can be emphasised or minimised in schools (Morawski, 2014). School is where students spend much of their time, and where socialisation occurs. Teachers and classmates are sources of learning about children's gender differences, attitudes, and behaviours. Mägi et al. (2019) stated that education is one of the central institutions that should be investigated to advance gender equality and equal opportunity. It is an effective method for altering society's perceptions and empowering the generation yet unborn. UNESCO (2009) highlighted that there continues to be widespread gender bias in school textbooks and curricula using stereotypical imagery or language.

In schools where formal knowledge is dispensed, stereotypical roles for both sexes are unconsciously taught and learned by the students. Moreover, an online discussion on gender sponsored by UNESCO revealed that teachers significantly impact whether harmful gender stereotypes are upheld or challenged in the classroom. Participants stated that by routinely asking for boys rather than girls or designating classroom activities along traditional lines, like having girls clean, teachers frequently unintentionally promote divides between boys and girls in school. Furthermore, the UNESCO report on Gender and Empowerment Measure (GEM) by Kate Redman indicated that less than

15% of countries include phrases such as "gender empowerment" or "gender-sensitive" in their curricula. While half mention "gender equality," indicating that gender bias is still a severe issue.

The Oxford Committee for Famine Relief (2007) stated that a high-quality education depends on gender equality in the classroom. If schools adopt top-notch gender-equitable curricula and teaching methods, students will be inspired to attend class and enjoy their time. According to Burger (2022), children may suffer if instructors' activities are not intentional and do not come from an environment of equity. One strategy to challenge gender norms is to allow students of different sexes to collaborate, especially in primary school, when children often prefer to choose friends and playmates. To prevent this, teachers should build a mixed-gender group that promotes successful cross-gender teamwork. This strategy enables children to learn new words, exhibit desired behaviours, and contribute to co-creating non-traditional gender roles.

Securing a gender-sensitive classroom does not revolve around the control of the classroom teacher or academic community members. The Scottish Executive Social Research (2006) clarified that parental involvement in gender-related issues contributes to the success of gender initiatives. Schools must emphasise the importance of parental participation since parents are an essential component of all programmes, and are responsible for the success of each project. Parents were frequently explicitly singled out, particularly those fathers who support their child's literacy and reading development. Sellnow (2018) contended that to promote gender equality in the classroom, teachers must involve all students in all activities. By working together in groups of two to five students to achieve objectives, students may begin to respect diverse perspectives and approaches to a topic, case study, or issue.

Even more, the prejudices that men dominate discussions while women speak more gently; or that she is self-effacing while he is a poor listener, can be stopped by including all students. Teachers must get to know every student if they want to engage them. To promote a gender-equal environment, it is also crucial that students are acquainted with one another and address one another by name. For instance, if changing the language of a true-or-false question makes it more straightforward for students to understand, this may be allowed. By putting concepts into practice, teachers can demonstrate to students that they value diverse perspectives and ways of knowing while inspiring them to continue learning throughout their lives. Additionally, Burger's (2022)

research revealed that the educational system promotes traditional ideas on gender stereotypes and traditional gender norms. Most teachers engage in gender-stigmatising behaviours in the classroom and subscribe to gender stereotypes. Teachers deny harbouring any gender preconceptions that they are not aware of or supporting them.

The menace of out-of-school children has posed a significant problem to achieving global education goals. While governmental and non-governmental organisations have tried to rescue the situation through various policies and programmes, such interventions have made little progress. Several empirical studies have examined the possible causes of the persistent increase in the number of out-of-school children. However, none have considered the issue of gender equality and gender-related stereotypes that could make schools unsafe for students' learning. In the light of the foregoing, this study investigated incidents of gender inequality within schools for the purpose of evaluating the effective strategies for promoting gender equality among pupils in Ibadan metropolis, Oyo state.

Gender discourse acknowledges that gender equality encompasses more than simply ensuring an equal number of boys and girls are enrolled in school. However, literature suggests that education policies operate within a very narrow frame, focusing primarily on equal access to education, as measured by the enrollment rates of girls versus boys in schools. This is reflected in policies such as the National Policy Framework for Women's Empowerment and Gender Equality, and the Education White Paper 6 on Inclusive Education, among others. There is a lack of emphasis on ensuring that girls and boys enjoy educational experiences of equal quality after gaining access to school, and there is also a lack of emphasis on developing critical gender consciousness following access to education. This oversight and the limited view of gender equality to only educational access have created another systemic disparity in education. In no small measure, this has complicated the issue of gender inequalities. Beyond creating equal access to education, this study explored effective strategies for promoting gender equality among primary school pupils.

Female and male learners do not have the same experiences in school, and most of the consulted literature agrees with this. Girls are often taken advantage of, and they are socialised into certain gender-specific roles, which has been a major factor in determining the outcome of women's lives for

generations. UNICEF (2012) argued that girls are expected to take on the roles of *homemakers* and 'child-bearers,' which has led to a culture that has reduced the importance put on women's educational attainment. Furthermore, gender inequities filter into the classroom in multiple and interrelated ways: through teachers' attitudes about gender; the curricula in general and specifically, gender and sexual violence against girls; and learner vulnerability to unplanned, parenthood (Chikwiri & Lemmer, 2017). These factors deeply impact students' career aspirations, achievements, and sense of agency. Although gender discrimination can be found in a classroom, a classroom is also a space where it can be dissected, viewed from several angles, and analysed from various perspectives, which could inform other views. Whether or not this happens is one of the factors that was considered in this study for determining effective strategies for promoting gender equality among primary school pupils.

Despite this, reflecting on the need for students to learn to reject any form of discrimination and abuse and internalise the values of equality is especially true when considering gender equality, as seen from both Kaba (2008) and Cretan & Turnock (2008). Kaba's research showed that although African American women have experienced the most severe forms of both racism and gender discrimination, they are still becoming a model minority in terms of college enrollment rates and other life outcomes. On the other hand, Cretan and Turnock (2008) highlighted the case of Roma people in Romania, who struggle to integrate into mainstream society due to their identity, which implies separation from a modernising ethos. Therefore, this points to the need for students to learn about these issues to understand why certain individuals or groups are marginalised, discriminated against, or marked as "the other". Students should also receive education on how to actively fight against such discrimination by internalising values of equality, such as respect for all individuals regardless of race, ethnicity, religion, or gender. Only then will students be able to reject any abuse and discrimination they may encounter truly truly.

Building on this research, literature revealed a lack of equality in classroom processes, school participation, and opportunities. Studies have shown that gender disparities in school activities start early, particularly among 12- or 13-year-olds, and these inequalities can continue into adulthood (Malavé, 2018; Beltrán et al., 2017; Guerrero-Puerta, 2017). Teachers can influence

individuals' students' habits and prevent gender inequality from forming. Addressing this issue requires synthesising the existing literature in an accessible and affordable way, and this study sought to do just that. In line with the foregoing, the study evaluated the effective strategies for promoting gender equality among primary school pupils.

This study aimed to evaluate effective strategies for promoting gender equality among primary and secondary education pupils in Ibadan metropolis, Oyo State. Specifically, the study:

1. investigated gender inequity among basic school pupils in Ibadan metropolis, Oyo State.
2. examined the challenges of gender equality among basic school pupils in Ibadan metropolis, Oyo State.
3. explored the strategies that can be employed to promote gender equality among basic school pupils in Ibadan metropolis, Oyo State.

Methodology

A descriptive survey research design was adopted for this study. The descriptive survey method is often used to collect information from a representative group, and based on this sample, inferences are drawn about the entire population's behaviour. The study population consisted of all teachers at basic schools in the Ibadan metropolis, Oyo State. Multi-stage sampling techniques were employed in this study. At the first stage, stratified sampling was employed to group the basic schools into LGAs. There are five LGAs in Ibadan Metropolis with about 1,576 basic schools. The researchers randomly selected thirty percent of all the basic schools. Random sampling techniques was used to select 473 basic schools and three teachers in each of the sampled schools. A total of 1,419 basic school teachers served as the participants for this study.

A researcher-designed questionnaire titled "Strategies for Promoting Gender Equality in Basic Schools (SPGEBS)" was employed for data collection. The questionnaire was divided into four sections: A, B, C, and D. Section A was used to collect demographic data from the respondents. Section B consisted of items that elicited information on gender inequity among primary school pupils. At the same time, Section C addressed the challenges of achieving gender equality among these pupils. Section D explored the strategies that can

be employed to promote gender equality in schools. The reliability of the instrument was determined by using a test-retest method with an interval of three weeks. The two scores obtained were correlated using the Pearson Product-Moment Correlation Coefficient, and a reliability index of 0.81 was obtained. Mean and rank order were used to answer the research questions one - three.

Data Analysis and Results

Descriptive mean and standard deviation statistics were used to answer research questions 1-3.

Research Question One: What is the extent of gender inequity among basic school pupils in Ibadan metropolis, Oyo State?

To answer this research question, the responses on the incidence of gender inequity among basic school pupils from the questionnaire were collated. The data collected were analysed using the summated mean. A cut-off point 2.50 was used as the baseline for answering the research questions, as the questionnaire was structured with a four-point response type. Therefore, items found with the mean scores equal or above 2.50 were affirmed while items with a mean score below 2.50 were remarked otherwise. The results are summarised in Table 1.

Table 1: Gender Inequity among Basic School Pupils in Ibadan Metropolis, Oyo State

Gender Inequity among Basic School Pupils	Mean	S.D.	Remark
I have on one or two occasions witnessed gender-based discrimination in my school.	3.55	.5344	Affirmed
I feel the male gender faces more inequality in my school	2.74	.5373	Affirmed
Girls in my school are discouraged from participating in sports and physical activities.	2.37	.5812	Disaffirmed
I have experienced or witnessed gender-based bullying in my school.	3.40	.5272	Affirmed

Both boys and girls have equal opportunities to participate in school events.	2.95	.8321	Affirmed
There are gender-specific clubs or groups in my school	2.31	.5649	Disaffirmed
Student have never been excluded from an activity because of their gender.	3.14	.7623	Affirmed
In the past, I have seen students discouraged from pursuing a subject or activity because of their gender.	3.17	.7628	Affirmed
Boys are sometimes discouraged from engaging in artistic and creative activities in my school.	2.88	.8456	Affirmed
I feel the female gender faces more inequality in my school	2.38	.6402	Disaffirmed
Weighted Mean Score	**28.89**		

Table 1 indicates that 150 respondents participated in this study. Responses to items that sought information on the extent of the incidences of gender inequity among basic school pupils in Ibadan metropolis revealed that the majority of the teachers perceived the extent of the incidences of gender inequity among basic school pupils in Ibadan metropolis as high because the benchmark weighted mean score (BWMS) stood at 25.0. Their weighted mean score (WMS) was 28.89, above the benchmark weighted mean score.

Research Question Two: What are the challenges of gender equality among basic school pupils in Ibadan metropolis, Oyo State?

Responses to the challenges of gender equality among basic school pupils from the questionnaire were collated. The data collected were analysed using the summated mean. A cut-off point of 2.50 was used as the baseline for answering the research questions, as the questionnaire was structured with a four-point response type. Therefore, items found with the mean scores equal or above 2.50 were affirmed while item with a mean score below 2.50 was remarked otherwise. The summary of the results is as shown in Table 3.

Table 3: The Challenges of Gender Equality among Basic School Pupils in Ibadan Metropolis, Oyo State

The Challenges of Gender Equality among Basic School Pupils	Mean	S.D.	Remark
Girls and boys are not given equal opportunities to participate in all school activities.	3.60	.550	Affirmed
Some teachers treat students differently based on their gender	3.14	.558	Affirmed
Some school activities promote gender stereotypes that prevent gender equality.	3.63	.544	Disaffirmed
Traditional gender roles and stereotypes affect expectations and opportunities available to students.	3.50	.658	Affirmed
School-related violence can disproportionately affect girls and other marginalized groups, creating an unsafe learning environment.	3.72	.514	Affirmed
A lack of awareness and understanding of gender issues among educators and students may perpetuate discrimination and exclusion.	3.50	.586	Disaffirmed
Inadequate facilities, such as separate and safe sanitation facilities for girls, hinder their attendance and participation in school.	2.46	.563	Disaffirmed
Deep-rooted cultural and societal norms influence attitudes towards gender roles, resulting in unequal treatment of boys and girls	2.77	.797	Affirmed

As shown in Table 3, it was affirmed that the challenges of gender equality among basic school pupils are reflected through unequal opportunities of girls and boys to participate in all school activities; teachers treating students

differently based on gender; some school activities promotes gender stereotypes that prevent gender equality; traditional gender roles and stereotypes affects expectations and opportunities available to students; school-related violence can disproportionately affect girls and other marginalized groups, creating an unsafe learning environment; lack of awareness and understanding of gender issues perpetuate discrimination and exclusion; and deep-rooted cultural and societal norms influence attitudes towards gender roles resulting in unequal treatment of boys and girls. However, it was disaffirmed that inadequate facilities, such as separate and safe sanitation facilities, hinder girls' attendance and participation in school.

Research Question Three: What strategies can be employed to promote gender equality among basic school pupils in Ibadan metropolis, Oyo State?

In order to answer this research question, responses on the strategies that can be employed to promote gender equality among basic school pupils from the questionnaire were collated. The data collected were analysed using the summated mean. A cut-off point of 2.50 was used as the baseline for answering the research questions since the questionnaire was structured in a four-point response type. Therefore, items found with the mean scores equal or above 2.50 were affirmed while item with mean score below 2.50 was remarked otherwise. The summary of the results is as shown in table 4.

Table 4: Strategies that can be employed to Promote Gender Equality among Basic School Pupils in Ibadan Metropolis, Oyo State

Strategies that can be employed to Promote Gender Equality among Basic School Pupils	Mean	S.D.	Remark
Educate boys and girls about gender equality and the importance of equal rights through the curriculum.	3.62	.547	Affirmed
Schools should enforce laws that promote gender equality and protect against gender-based discrimination and violence.	3.62	.624	Affirmed

Give equal access to both genders to participate in school students' leadership positions.	3.65	.481	Affirmed
Men and boys should be encouraged to be allies in promoting gender equality and to challenge harmful gender norms.	3.74	.444	Affirmed
Effective policies that would curb gender inequality in schools should be formulated.	3.71	.520	Affirmed
Sporting activities that promote gender equality should be encouraged.	3.60	.550	Affirmed
Sensitive cultural norms that perpetuate gender inequality in school should be tackled.	3.54	.558	Affirmed

As shown in Table 4, it was affirmed that the strategies that can be employed to promote gender equality among basic school pupils include to educate students about gender equality and the importance of equal rights through curriculum teaching, enforce laws that promote gender equality and protect against gender-based discrimination and violence, give equal access to both gender to participate in school students' leadership positions, boys and men should be encourage to be allies in promoting gender equality and to challenge harmful gender norms, effective policies that would curb gender inequality in schools should be formulated, sporting activities that promote gender equality should be encouraged and sensitive cultural norms that perpetuate gender inequality in school should be tackled.

Discussion

Findings from this study revealed that most teachers perceived the extent of gender inequity among basic school pupils in Ibadan metropolis to be high. A majority of the respondents revealed that they had witnessed one or two occasions of gender-based discrimination in their school, felt that the male gender faces more inequality in my school, experienced or witnessed gender-based bullying in their schools, seen students discouraged from pursuing a subject or activity because of their gender, and that boys are sometime

discouraged from engaging in artistic and creative activities in my school. This findings supported Leach and Machakanja's (2020) study which examined the abuse of junior secondary school girls by older boys, teachers and 'sugar daddies' in Zimbabwe, Ghana and Malawi, and found that there was a high level of sexual aggression from boys, which went largely unpunished in the schools, and some cases of teachers propositioning girls for sex. This behaviour was largely tolerated and normalised. All three educational systems were characterised by a reluctance to take action against either teachers or pupils. Teachers downplayed or dismissed the suggestion that some teachers had sex with their pupils, although both male and female pupils talked about teachers offering to give girls high grades or gifts in exchange for sex. At the same time, there was reluctance among girls to report incidents for fear of being blamed for having 'invited' the abuse, being ridiculed or victimised (e.g., a male teacher singling a girl out for beating in class because she turned him down, or threatening to fail her in tests and exams).

Another finding of the study revealed that the challenges of gender equality among basic school pupils are reflected through unequal opportunities of girls and boys to participate in all school activities. This include teachers treating students differently based on gender; some school activities promotes gender stereotypes that prevent gender equality; traditional gender roles and stereotypes affects expectations and opportunities available to students; school-related violence can disproportionately affect girls and other marginalised groups, creating an unsafe learning environment; lack of awareness and understanding of gender issues perpetuate discrimination and exclusion; and deep-rooted cultural and societal norms influence attitudes towards gender roles resulting in unequal treatment of boys and girls. However, it was disaffirmed that inadequate facilities, such as separate and safe sanitation facilities, hinder girls' attendance and participation in school. This finding corroborated Adeju's (2019) finding that the challenges of gender equality in schools are systemic and deeply rooted in society's cultural background. According to the author, these challenges and factors can affect the realisation of gender equality if they are not controlled. In unveiling the challenges, Adeju (2019) agreed with USAID (2008), UNICEF and UNGEI (2009), and IIEP (2011) that these challenges include: poverty, prohibitive religious practices and beliefs, traditional social-cultural practices, women's under-representation in key decision-making positions, increased violence against women, and limited infrastructure and amenities.

In addition, the study revealed that the strategies that can be employed to promote gender equality among basic school pupils include to educate students about gender equality and the importance of equal rights through curriculum teaching, enforcing laws that promote gender equality and protect against gender-based discrimination and violence, giving equal access to both gender to participate in school students' leadership positions, boys and men should be encourage to be allies in promoting gender equality and to challenge harmful gender norms, effective policies that would curb gender inequality in schools should be formulated, sporting activities that promote gender equality should be encouraged and sensitive cultural norms that perpetuate gender inequality in school should be tackled. This finding is in tandem with the discoveries by Omotola (2018) that Gender inequality in schools is a widespread barrier to girls' attaining educational equity, which also brings with it many health risks. The authors suggested that addressing power imbalances between men and women is central to preventing gender inequality and violence, and this process must be deeply rooted in schools. Tolani (2019) placed emphasis on the fact that successful efforts to avoid gender inequality must include both boys and girls. The lives of girls/women and boys/men are intimately interwoven, and working only with girls is, at best, only half a solution. Framing the issue in the polarising language of girls versus boys, victims versus perpetrators, only exacerbates an already difficult situation and masks the complexity of the dynamics of gender and power. Working with girls and boys, sometimes together and sometimes separately, depending on the social context, is the only way to implement approaches that can truly reshape the construction of gender roles. This transformative approach is key to long-term success. Adeju (2019) also highlighted that gender inequality and violence have not been systematically confronted in the developing world, but several initiatives have been undertaken. These initiatives reflect a variety of approaches, including curriculum development, youth leadership, teacher training, advocacy, community involvement, and policy development. Larkin (2014) posited that a possible solution to gender inequality and violence against female students in schools is to organise symposiums, workshops, and seminars against the use of violence against female students.

Conclusion

The study examined the effective strategies for promoting gender equality among basic school pupils in Ibadan metropolis, Oyo State, revealing a

significant perception of gender inequity at the basic school level, with teachers observing high incidences of unequal treatment between boys and girls. The challenges that were identified encompassed a broad spectrum of issues, from unequal participation opportunities in school activities to societal norms that perpetuate gender roles and stereotypes. These challenges contribute to an environment that can be discriminatory and unsafe, particularly for girls and marginalised groups. However, the study also outlined a comprehensive range of strategies to address these issues, emphasising the importance of education on gender equality, enforcement of protective laws, equal access to leadership roles, and promoting gender-equitable school policies and activities.

Recommendations

In line with the findings of this study, the following recommendations were proposed to address gender inequity among basic school pupils in Ibadan metropolis. These recommendations aimed to create a more equitable educational environment where students can thrive without the constraints of gender-based inequality.

1. School authorities should implement comprehensive gender sensitivity training for teachers to ensure equitable treatment and opportunities for all students, regardless of gender.
2. Educational institutions should develop and integrate a curriculum that emphasises gender equality and the importance of equal rights, which could help dismantle traditional gender roles and stereotypes.
3. Schools should establish and enforce school policies that actively promote gender equality and protect students from gender-based discrimination and violence.
4. Educational institutions should create inclusive school activities and leadership opportunities that are accessible to all students, encouraging the participation of both girls and boys equally.
5. Teachers should engage boys and men in the conversation about gender equality, empowering them to become allies and advocates for change within their school communities.

6. Schools and educational institutions should promote sports and extracurricular activities that support gender equality, providing a platform for all students to engage and excel.
7. Educational institutions should address and challenge cultural norms and practices within the school environment that perpetuate gender inequality, ensuring a safe and supportive learning space for every student.

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CHAPTER TWENTY-FOUR

Assessment of Maternal Knowledge on Exclusive Breastfeeding and Nutritional Status of Infants (0-6 months) in Ilorin South, Nigeria

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Abstract

The study investigated maternal knowledge of exclusive breastfeeding and the nutritional status of infants (0-6 months) in the Ilorin South Local Government Area, Ilorin, Kwara State. Five research questions were raised, and two null hypotheses were formulated. A descriptive survey research design was adopted for the study, with the population comprising 2,754 lactating mothers from whom two hundred (200) were selected using multistage sampling. A structured questionnaire was used as the instrument for data collection, which had a reliability coefficient of .952. Findings of the study revealed that 172 (86%) of the respondents (3.18) were aware of exclusive breastfeeding; 120 (60%) of the respondents (2.79) practised exclusive breastfeeding; and 118 infants had B.M.I. values below 18.5, indicating that they were undernourished. 140 (70%) of the respondents (2.84) agreed that maternal knowledge on exclusive breastfeeding influenced their willingness and practice of exclusive breastfeeding. There is a significant difference between the nutritional status of exclusively and non-exclusively breastfed infants ($p < 0.05$), and the level of maternal knowledge significantly influences exclusive breastfeeding ($p < 0.05$). The study concluded that a majority of breastfeeding mothers have knowledge of exclusive breastfeeding. It is recommended that lactating mothers practice exclusive breastfeeding.

Keywords: Exclusive breastfeeding, Nutritional status, Maternal knowledge, Infants.

Introduction

Knowledge is the product of information provided and received systematically on a given subject. Information is defined by Olajide (2015) as facts and opinions provided and received in the course of human daily activities. Facts communicated and received on a subject are capable of modifying the knowledge state of an individual. Kadir, (2019) stated that nutritional status can be interpreted as a nutritional health condition of the community, which is very dependent on the level of food consumption needed by the body, the composition of food and its comparison with one another. Nutritional status is a condition driven by dietary intake as well as the use of nutrients digested and absorbed by the diet intake. Nutritional status can be malnutrition, good nutrition and over nutrition (Kemenkes, 2018). Good nutritional status can be the foundation of sound health that will optimise growth and development and reduce morbidity, disability, and death so that it will affect the quality of human resources. Conversely, poor or excessive nutritional status has a bad impact - both short and long term. Children who are mal-nourished will be very potentially affected by the disease. Thus, provision of knowledge for lactating mothers on infants' nutritional status as well as its relationship with exclusive breast feeding practices is necessary if the health growth and development is required among babies (Kadir, 2019). This knowledge can be delivered through different media such as oral, print and non- print resource. It can also be delivered through the use of information and communication technologies such as radio and television stations.

Breast milk is nutritionally composed, digests easily, promotes immunity and enhances healthy growth in infants. Breast milk alone provides all of the nutritional need - both macro and micro nutrients, be it vitamins and minerals. Hence, no other liquid or food is needed (Tahiru *et.al.* 2020). Studies have shown that knowledge of exclusive breastfeeding among the lactating mothers are high while the practice is very low. However, in the past, breast feeding was generally acknowledged across the world among all human group, communities, societies and cultures as the most suitable form of infant feeding, which is based on scientific evidence that support the essential role of breast feeding in the survival, growth, maturation and development of a child (Operto, 2020). However, breast feeding practice is being gradually replaced by artificial body food, but breastfed children have greater chance of survival in the early month than non-breastfed children (Samuel *et al.,* 2020). Breast

feeding plays the fundamental and essential component of the development and child-survival strategy. Breast milk is the first natural food for babies. It provides all the essential energy and nutrients that the infant needs for the first six months of life. It provides major child's nutritional needs during the second half of the first year, and up to one third during the second year of life Sobkoviak *et al.*, (2012).

On the other hand, breast milk is considered as the most complete nutritional source for infants because it contains essential fats, carbohydrates, proteins, and immunological factors needed for infants to thrive and resist infection in the first six (6) month of life (Awano *et al.,* 2010). Breast milk is made up of the necessary nutrients that infants need for healthy growth and development, protecting them from gastrointestinal respiratory infections, obesity, risk of allergies, endocrine diseases, and promotes mental health and psychomotor development (Kramer *et al.,* 2012). Although, it is widely known that breastfeeding is an important step in the reproductive process of women and its practice offers benefits to both mother and child, the offering of the maternal breast to the infant is an unquestionable right of mothers. Most of the available information highlighted the benefits of breast milk for infant, while the effects of breastfeeding on the health of the infant and also to the mother have also been well documented(Del Ciampo *et al*., 2018). According to United Nation Children's Fund, it has been estimated that 1.3 million deaths could be prevented and most of childhood illness can be eliminated each year if babies were exclusively breastfed for the first six months of life. The breast milk contains numerous substances such as water, protein, fat, carbohydrates, vitamins minerals and colostrums, which provide protective antibodies that boost the infant's immune system.

Exclusively breastfeeding can be defined as a practice whereby the infants receive only breast milk and not even water, other liquids, tea, herbal preparations or food during the first six months of life, with the exception of vitamins, minerals supplements or medicine. Breastfeeding is less stressful; it requires no cleaning of plates or bottles, no heating of feeds, no modification of milk. In addition, breast milk is cheap. Exclusive breastfeeding (EBF) for the first six (6) months of life improves the growth, health and survival status of infants (World Health Organisation, 2003); and it is one of the most natural and best forms of preventive medicine (Geneva *et al.,* 1991). Exclusive breastfeeding is the provision of only breast milk as food for an infant without

any other liquid except syrups, which may be medicines or vitamins. Food is important in the life of every human being because it provides energy and nutrients required for activities, growth, repair and prevention of diseases (Olofin, 2016). When an infant is poorly fed, it becomes weak, loses weight and becomes inactive and can be easily attacked by infectious diseases. In 2002, the World Health Organisation and UNICEF adopted the Global Strategy for infant and feeding. The strategy was developed to revitalise world attention to the impact that exclusive breastfeeding practices have on the nutritional status, growth development as well as on the health, and survival of infants. World Health Organization (WHO) recommended exclusive breastfeeding for the first six months of life and continuation of breastfeeding should be adhered to thereafter; or before the introduction of adequate complementary foods for up to two years of age or beyond.

However, inadequate maternal knowledge about exclusive breastfeeding is affecting the practice in different dimensions. Some factors that contribute to the problem of inadequate knowldge include custom, tradition, desire for mothers to maintain their shape, desire for the breast not sagging, working place, family income, mothers health problem and career women. Kramer *et al.,* (2012) postulated that non-exclusively breastfed infants are at higher risk of being exposed to morbidity and mortality. Exclusive breastfeeding creates a rewarding opportunity for interaction between mother, child; and also has a positive impact on the mother's health. Yet, the practice is on the decline (Angadi *et al*., 2015). The consequences of poor infant feeding by not practicing exclusive breastfeeding among mothers is one of the major problem and serious obstacle to health issues affecting infants nutritional status and their health. This study, therefore, explored the level of maternal knowledge and practices of exclusive breastfeeding in order to establish a relationship between exclusive breastfeeding and nutritional status of infants (0-6 months) in Ilorin South Local Government Area of Kwara State.

Objective of the Study

The general objective of the study was to assess maternal knowledge on exclusive breastfeeding and nutritional status of infant (0-6 months) in Ilorin South Local Government Area of Kwara State. The specific objective were to:

1. assess the level of maternal knowledge on exclusive breastfeeding among lactating women in Ilorin South Local Government Area of Kwara State;
2. investigate the extent at which lactating mothers in Ilorin South Local Government of Kwara State practice exclusive breastfeeding;
3. determine the BMI and nutritional status of infants (0-6months) in Ilorin South Local Government Area of Kwara State; and
4. investigate the influence of maternal knowledge on exclusive breastfeeding among lactating women in Ilorin South Local Government Area of Kwara State.

Research Questions

These questions are raised as guidelines for the study

1. What is the level of maternal knowledge on exclusive breastfeeding among lactating women in Ilorin South Local Government Area of Kwara State?
2. What is the level of exclusive breastfeeding practices among lactating mothers in Ilorin South Local Government Area of Kwara State?
3. What are the BMI and nutritional status of infants (0-6months) in Ilorin South South Local Government Area of Kwara State?
4. What is the influence of maternal knowledge on exclusive breastfeeding among lactating women in Ilorin South Local Government Area of Kwara State?

Research hypotheses

The following null hypothesis were formulated to guide the study

1. There is no significance difference in the nutritional status of exclusively and nonexclusively breastfed infants.
2. Maternal nutritional knowledge does not significantly influence exclusive breastfeeding practices among lactating mothers.

Methodology

The study adopted a descriptive survey research design. Descriptive survey method of research is concerned with generalized statistic resulting when data

are obtained from part of a large population and used to generalize (Ekeh, 2003).

The population of this study comprised all the Two Thousand Seven Hundred and Fifty Four (2,754) lactating mothers from two selected hospital in Ilorin South Local Government Area of Kwara State.

Two Hundred (200) lactating mothers were selected from the population, using multistage sampling technique, which represented 7.3% of the population. The multistage sampling techniques was used in the study as follows: Stage1: involved stratifying the state into Local Government. Stage 2: involved selecting one Local Government (Ilorin south) which is the study area. Stage 3: involved using random sampling techniques to select two (2) District/Wards from the Local government. Stage 4: involved using proportionate stratified sampling techniques to determine the number of respondents to be sampled from each District/Ward. The total sample obtained was two hundred (200), which as it has been mentioned, represented 7.3% of the population.

A structured questionnaire tagged Influence of Maternal Knowledge on Exclusive Breastfeeding Questionnaire (IMKEBQ) was used to obtain information from lactating mothers in the Local Government Area. The instrument was developed by the researcher based on the objectives and research questions formulated for the study. The data obtained from the pilot study was subjected to statistical analysis to determine the reliability co-efficient of the instrument. The reliability co-efficient obtained was .952.

Data were collected from respondents by administering the questionnaires. The questionnaires were administered to lactating mothers in the selected hospitals within the Local Government selected for this study with the help of a research assistant. Data collected were subjected to descriptive and inferential analysis, using Statistical package for social sciences (SPSS version 20.0). Research questions were analysed using descriptive statistics (frequency, percentage, mean and standard deviation).The null hypotheses formulated were tested using inferential statistics such as t-test and Pearson Product Moment Correlation (PPMC) at 0.05 levels of significance.

Results and Discussions

Demographic Characteristics of the Respondents

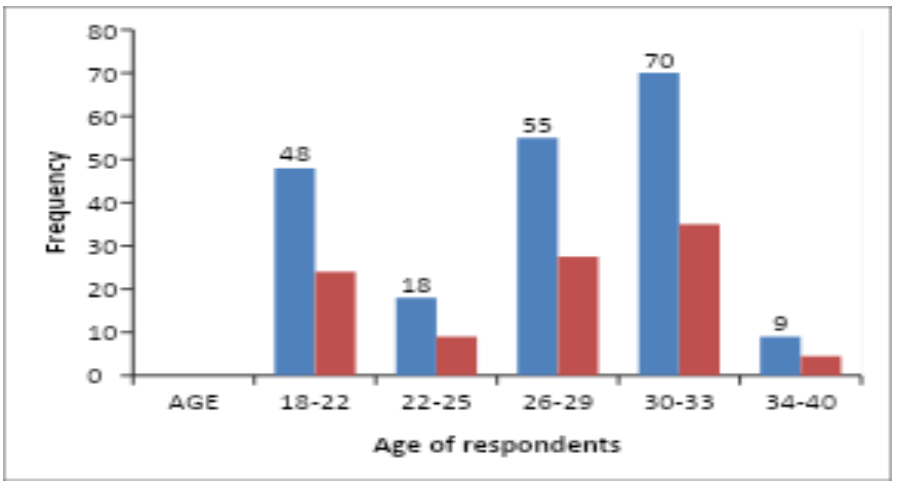


Figure 1: Age of the Respondents

Figured **1** shows that the age range of the respondents. Forty-eight (48) (24.0%) of the respondents were between age range of 18-21 years, 18(9.0%) of the total respondents were between the age range of 22-25, 55 (27.5%) were between the age range of 26-29, 70 (35.0%) were between the age of 30-33 and 9 (4.5.0%) were between the age of 34-40. It can be deduced that a majority of the respondents were between 30-33 years.

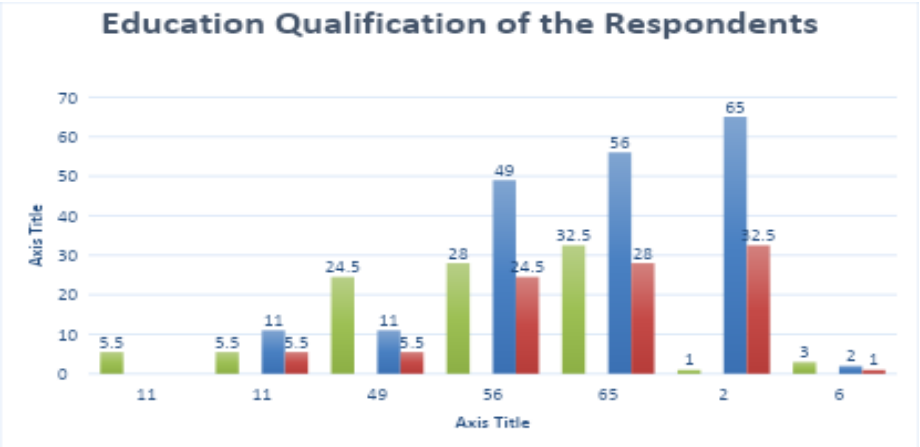


Figure 2: Education Qualification

The education qualification of the respondents revealed that 11 (5.5%) of the lactating parents had no formal education, 11 (5.5%) of the parent were primary school leavers, 49 (24.5%) of the parents had only SSCE, 56 (28%) of the lactating parents were either NCE or OND holders, 65 (32.5%) of the lactating parents were either BSc or HND holders, 2 (1%) of the lactating parents were MSc holders while 6 (3%) of the lactating parents had educational qualification up to Ph.D.

Level of Maternal Knowledge on Exclusive Breastfeeding

Table 1: Level of maternal knowledge on exclusive breastfeeding

Statements	Agreed %	Disagreed %	Mean	S.D	Remark
I am aware of exclusiv breastfeeding	172(86)	28(14)	3.18	0.71	Agreed
I breastfeed my infants exclusively	143(71.5)	57(28.5)	2.99	0.85	Agreed
Every lactating mother understand the term exclusive breastfeeding	84(42)	116(58)	2.49	0.80	Disagreed
I practice exclusive breastfeeding for all my babies	120(60)	80(40)	2.79	0.84	Agreed
Exclusive breastfeeding is important	118(59)	82(41)	2.77	1.04	Agreed
I have heard about exclusive breastfeeding	153(77)	47(23)	2.99	1.00	Agreed
Exclusive breastfeeding improves infant immunity	120(60)	80(40)	2.71	1.03	Agreed
Exclusive breastfeeding allows child spacing	97(48.5)	103(51.5)	2.45	1.02	Disagreed
Exclusive breastfeeding is feeding of infants for about	110(55)	90(45)	2.65	1.08	Agreed

six month

Sources: Field Survey, 2021

The benchmark used for the decision of this result was 2.5. A mean rating of any of the items by the respondents equal or above 2.5 was taken as agreed while the rating below 2.5 was taken as Disagreed.

Table 1 shows the frequency, percentage, mean distribution and standard deviation on the level of maternal knowledge on exclusive breastfeeding in Ilorin South Local Government Area. The Table revealed the level of maternal knowledge of lactating mothers within Ilorin South. However, most of the items in the table had a mean score that was above the benchmark of 2.5, implying a high level of maternal knowledge. More so, 172 (86%) of the respondents with mean score of 3.18 were aware of exclusive breastfeeding, 143 (71.5%) of the respondents with a mean score of 2.99 breast feeded their infants exclusively, 120 (60%) of the respondents with the mean score of 2.79 practiced exclusive breastfeeding for their infants, 120 (60%) with the mean score of 2.71 agreed that exclusive breastfeeding improves infants immunity while 116 (58) with the mean score 2.49 disagreed that every lactating mother understands the term exclusive breastfeeding. Also, 103 (51.5) with the mean score 2.45 disagreed that exclusive breastfeeding allows child's spacing.

This implied that the level of maternal knowledge on exclusive breastfeeding is high 172 (86%) and this agrees with Afolabi (2003) who discovered that the acquisition and utilisation of knowledge, especially in the area of health, helps in preserving and enriching lives. Thus, provision of knowledge or facts on exclusive breastfeeding to lactating mothers is necessary as its application encourages continuity of the natural process of human development which starts in the womb.

Level of Practice of Exclusive Breastfeeding among Lactating Mothers

Table 2: Mean Rating and Standard Deviation of Respondents on the extent at which lactating mothers practice exclusive breastfeeding

Statements	Agreed %	Disagreed %	Mean	Standard Deviation	Remark
All mothers give water fir six months	74(37) 123(61.5	126(63)	2.38	0.77	Disagreed

No liquid aside medicine is giving to infant	)	77(38.5)	278	0.99	Agreed
Food and water should be giving to infants less than six months	118(59)	82(41)	2.58	0.97	Agreed
Most mothers do not practice because they believe it is punishment to infants	69(34.5)	131(65.5)	2.26	0.79	Disagreed
I believe in exclusive breastfeeding	110(55)	90(45)	2.61	0.97	Agreed
I practice exclusive breastfeeding	120(60)	80(40)	2.74	1.05	Agreed

Sources: Field Survey, 2021

Table 2 revealed that a majority of the respondents agreed on the extent to which lactating mothers practice exclusive breastfeeding. However, 123 (61.5%) of the respondents with mean score of 2.78 agreed that no other liquid aside from medicine and vitamin supplement is to be given to infants in the practice of exclusive breastfeeding, 110 (55%) of the respondents with a mean score of 2.61 agreed that they believe in exclusive breastfeeding, 120 (60%) of the respondents with the mean score of 2.74 agreed that they practice exclusive breastfeeding, while 126 (64%) with the mean score 2.38 disagreed that all lactating mothers give water to infants for the first six months. Also, 131 (65.5%) of the respondents with the mean score 2.26 disagreed that most lactating mothers tend not to practice exclusive breastfeeding because they assume it is a form of punishment to infants. This implies that a majority 126 (64%) lactating mothers practiced exclusive breastfeeding. The finding partly agrees with the study of Samuel *et al.*, (2020) who reported that in industrial countries, many working mothers do not breast feed their children due to work force and very short period of maternity leaves.

Table 3: BMI and Nutritional status of infants (0-6 months) in Ilorin South LGA with frequency and their percentage

BMI	Remark	Frequency	Percentage%
Below 18.5	Underweight	118	59
18.5-24.9	Normal	82	41
Above 25	Overweight	--	--
Total		200	100

Source: field survey 2021

Table 3 presents the nutritional status of the infants (0-6 months) in Ilorin South Local Government Area. The nutritional status of the infants was determined from their BMI value calculated from the weight and height of the infants. In calculating the BMI, the weight of the respondents was taken and recorded in kilogram and height was taken with tape rule and record in meter. BMI was calculated by dividing the weights in kilogram by square of the heights in meters. Any value less than 18.5 was rated as underweight; values ranging from 18.5 - 24.9 were rated as normal weight while values ranging from 25.0 - 29.9 were rated as overweight.

However, the result of the findings revealed that 118 (59%) of the infants were underweight, 82(41%) of the infants had normal weight, but none of the infants was overweighed. This shows that a majority (59%) of the infants in Ilorin South Local Government were underweighted.

Influence of Maternal Knowledge on Exclusive Breastfeeding

Table 4: Mean Rating and Standard Deviation of Respondents on the influences of maternal knowledge on exclusive breastfeeding

Sources: Field Survey, 2021

Table 4 shows the frequency, percentage, mean distribution and standard deviation on the influences of maternal knowledge on exclusive breastfeeding. The table reveals that a majority of the respondents agreed on the influences of maternal knowledge on exclusive breastfeeding. However, 140 (70%) of the respondents with mean score of 2.84 agreed that maternal knowledge on exclusive breastfeeding influences practice, 138 (69%) of the respondents with a mean score of 2.90 agreed that lack of knowledge prevents the practice, 122 (61%) of the respondents with the mean score of 2.69 agreed that some mothers do not practice exclusive breastfeeding because they do not want to lose shape, 98 (64%) with the mean score 2.33 disagreed that societal influences as mother's job do not prevents exclusive breastfeeding. This agrees

Statements	Agreed %	Disagreed %	Mean	Standard Deviation	Remark
Maternal knowledg influences practice	140(70)	60(30)	2.84	0.81	Agreed
Lack of knowledg prevents practice	138(69)	62 (31)	2.90	1.04	Agreed
Some mothers don't practice as they don't want to lose shape	122(61)	78(39)	2.69	1.32	Agreed
Societal influences as mother's job do not prevent exclusive breastfeeding	72(36)	98(64)	2.33	0.94	Disagreed

with Tahiru *et.al.* (2020) who revealed that the majority of the mothers, who engaged in some forms of employment, are unable to exclusively breastfeed because facilities at their work places and conditions of work do not support exclusive breast-feeding. In all, maternal knowledge, physical appearance as

well as societal influences affect the practice of exclusive breastfeeding among lactating mothers

Hypotheses Testing

$H0_1$: There is no significance difference in the nutritional status of exclusively and nonexclusively breastfed infants

Table 5: t-test comparing respondents' view nutritional status of exclusively and non-exclusively breastfed infants

V	N	Mean	SD	df	t	Sig.2tailed	Remark
Exclusive		11.34	3.46				
Non-exclusive	200			199	36.125	.000	Rejected
Test value		2.5	0.95				

*Significant at P<0.05

Sources: Field Survey, 2021

Table 5 presents a calculated t-value of 36.125, with a corresponding degree of freedom (df) 36.125 and p-value of .000. The p-value of 0.000 is lesser than the 0.05 alpha levels, indicating that exclusively and non-exclusively breastfed infants are statistically different. Therefore, it is concluded that the null hypothesis, which stated that there is no significant difference between the nutritional statuses of exclusively and non-exclusively breastfed infants, was rejected.

This implies that there is a significant difference between the nutritional status of exclusively and non-exclusively breastfed infants in Ilorin South ($p < 0.05$). This is in consonant with Samuel *et.al.* (2020) who postulated that breastfed children have greater chance of survival in the early month than non-breastfed children, hence their nutritional status.

Maternal nutritional knowledge will not significantly influence exclusive breastfeeding practices among lactating mothers.

Table 6: Pearson Product Moment Correlation(PPMC) on influence of maternal knowledge

on exclusive breastfeeding practices

V	N	Mean	SD	N	r	Sig.	2tailed	Remark
Maternal	200	25.13	6.61					
				200	.621	.000		Rejected
Exclusive	200	10.70	3.26					

*Significant at P<0.05

Source: Field survey, 2021

Table 6 shows a Pearson r of .621** and a p value of .000, testing at an alpha level of 0.05. ($p < 0.05$). The Pearson r of .621** shows a moderate correlation between the maternal knowledge and exclusive breastfeeding. Since the p-value of .000 is lesser than alpha level of 0.05, the null hypothesis, which stated that maternal knowledge will not significantly influence exclusive breastfeeding, was therefore rejected. This implies that level of maternal knowledge significantly influence exclusive breastfeeding. This agrees with Kadir (2019), who stated maternal knowledge influences exclusive breastfeeding practices.

Conclusion

With the finding of the study, it was concluded that a majority of the lactating mothers have knowledge of exclusive breastfeeding, but they do not practice it. Therefore, maternal knowledge of exclusive breastfeeding greatly affects its practice. Significantly, the nutritional status of infants that are exclusively breastfed differs from those that are not.

Recommendations

Based on these findings of the study, the following recommendations are offered:

1. Breastfeeding mothers should practice exclusive breastfeeding- as having just the knowledge is not enough.
2. Proper awareness should be provided on the benefits of exclusive breastfeeding on infants to the lactating mothers infants. Lactating mothers should be encouraged to attend postnatal clinic in order to get more information from health care professionals.
3. Exclusive breastfeeding should be encouraged in our society, especially among working class lactating mothers.

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CHAPTER TWENTY-FIVE

Curriculum Internationalisation in Nigerian Higher Education: A Strategic Approach to Global Practice

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Abstract

The internationalisation of curricula in Nigerian higher education is essential for aligning academic programmes with global standards and equipping graduates with the skills needed to thrive in an interconnected world. However, challenges such as outdated curricula, limited international collaborations, and inadequate policy frameworks hinder this progress. This study examined the significance of curriculum internationalisation, focusing on key elements of internationalisation, such as global partnerships, student and faculty mobility, multilingual education, and the integration of international perspectives into teaching and research. To achieve its objectives, the study proposed a strategic framework that included policy reforms, curriculum development, transnational education programmes, and the adoption of digital and multilingual content. By implementing these strategies, Nigerian universities can enhance their global competitiveness, bridge the gap between local and international educational standards, and produce graduates who are well-equipped for diverse professional environments.

Keywords: Curriculum Internationalisation, Higher Education, Global Practice, Nigerian Universities.

Introduction

The 21st century has ushered in an era of unprecedented global interconnectedness, fundamentally reshaping the landscape of higher education worldwide. Within the dynamic and increasingly integrated global ecosystem that defines contemporary higher education, the internationalisation of curricula for Nigerian universities has transcended the status of a merely desirable aspiration. It has evolved into a critical and non-negotiable strategic imperative that is fundamental to ensuring sustained institutional relevance in a rapidly evolving global academic landscape. It is meant to achieve and maintain academic excellence by aligning with international standards and best

practices. It is also the desirable way of facilitating the production of graduates who are not only academically proficient but also possess the essential knowledge, skills, and global competencies required to effectively navigate, contribute meaningfully, and thrive ethically within a complex and interconnected globalized world. As higher education institutions across the globe actively adapt their academic offerings to respond to the multifaceted demands of globalisation, the ever-expanding knowledge economies, and the escalating prevalence of transnational academic exchanges and collaborations, the Nigerian higher education system must undergo a parallel and equally profound transformation. In this context, curriculum internationalisation is understood as the deliberate, systematic, and ongoing process of integrating international, intercultural, and global dimensions into the very fabric of academic programmes, encompassing their content, pedagogical approaches, assessment methodologies, learning outcomes, and the overall student experience (Knight, 2004).

This study examined the critical significance of curriculum internationalisation within the specific context of Nigerian higher education. It underscored the urgent and compelling need to strategically align local academic content, pedagogical practices, and institutional frameworks with prevailing global standards and best practices. Furthermore, it identified and analysed the key challenges and systemic obstacles that currently impede the widespread and effective implementation of curriculum internationalisation initiatives across Nigerian universities. Building upon this critical analysis, the study culminated in the proposition of a robust, multifaceted, and actionable strategic framework designed to facilitate transformative change within the sector. This framework encompasses the urgent need for comprehensive policy reforms at the national level, the implementation of targeted and sustained curriculum development initiatives designed to foster global pedagogical competence, the establishment and robust support of transnational education programmes that foster cross-border academic collaboration, and the judicious and effective adoption of digital technologies and multilingual learning resources to broaden access and enhance global engagement. Ultimately, this paper argued that the concerted and strategic implementation of these recommendations will not only enhance the global competitiveness and standing of Nigerian universities significantly, but will also play a crucial role in bridging the existing gap between local and international educational standards. This will thereby equip Nigerian graduates with the essential knowledge, skills, and global competencies required to

navigate and contribute meaningfully to diverse and dynamic global professional environments.

The Imperative of Curriculum Internationalisation for Nigerian Higher Education in a Globalised World

The rationale for prioritising the comprehensive internationalisation of curricula within Nigerian higher education is multifaceted and deeply rooted in the evolving dynamics of the global landscape. Firstly, in an era defined by intricately interconnected economies, thriving transnational collaborations across diverse sectors, and the increasing fluidity of global talent, graduates emerging from Nigerian universities must possess a well-developed global mind-set, a deep understanding of intercultural competence, and the demonstrable ability to effectively navigate and contribute within diverse cultural and professional environments. An intentionally internationalised curriculum serves as a powerful catalyst in fostering these crucial attributes by systematically exposing students to a broad spectrum of diverse perspectives, fostering critical engagement with complex global issues, and cultivating essential cross-cultural communication and collaboration skills (Leask, 2015). This, in turn, enhances their adaptability, employability, and capacity to contribute effectively to a globalised workforce.

Secondly, curriculum internationalisation functions as a vital and dynamic mechanism for the continuous enhancement of the quality, relevance, and overall rigour of academic programmes offered by Nigerian universities. By strategically benchmarking against internationally recognised standards of academic excellence and proactively incorporating globally recognised best practices in curriculum design, pedagogical innovation, and assessment methodologies, Nigerian universities can ensure that their academic offerings remain current, intellectually stimulating, and directly aligned with the evolving demands of the global knowledge economy. This strategic alignment is not merely an academic exercise; it is a crucial determinant in significantly improving the employability prospects of Nigerian graduates, both within the domestic job market and in the increasingly competitive international arena (British Council, 2016).

Thirdly, the process of internationalisation can serve as a potent catalyst for stimulating innovation, fostering cutting-edge research, and cultivating a vibrant intellectual environment within Nigerian universities. Increased

exposure to international research trends, the establishment of collaborative research projects with esteemed foreign institutions, and the strategic integration of global case studies and perspectives into research agendas can significantly enrich the academic landscape and foster a robust culture of intellectual inquiry that is capable of addressing both pressing local challenges and complex global issues. Furthermore, a commitment to internationalisation can enhance the attractiveness of Nigerian universities to international students, visiting scholars, and globally recognised faculty, thereby contributing to a more diverse, intellectually stimulating, and globally connected academic community.

Finally, curriculum internationalization plays a pivotal role in significantly enhancing the global standing, international reputation, and overall visibility of Nigerian universities within the global academic community. Institutions that actively and strategically engage in meaningful international collaborations, offer academic programmes that are recognised and respected internationally, and consistently produce graduates who demonstrate global competence and ethical engagement, are far more likely to attract valuable international partnerships, secure competitive international research funding opportunities, and reap increased recognition and prestige within the global higher education landscape (Altbach & Knight, 2007). This enhanced global standing can, in turn, attract further international collaborations and opportunities, creating a virtuous cycle of growth and development.

Challenges Impeding the Advancement of Curriculum Internationalisation in Nigerian Higher Education

Despite the compelling arguments for and the evident benefits of curriculum internationalisation, the effective and widespread implementation of such initiatives within Nigerian higher education continues to be hampered by a constellation of significant and often deeply entrenched challenges:

- **Persistence of Outdated Curricula:** A significant number of academic programmes across Nigerian universities still operate with curricula that have not undergone adequate and timely revisions to reflect the rapid advancements in global knowledge, the transformative impact of emerging technologies, and the evolution of contemporary pedagogical approaches. This inertia can result in graduates who are ill-equipped with the cutting-edge skills, contemporary knowledge, and global

perspectives that are increasingly demanded by the dynamic global marketplace. The lack of regular curriculum reviews, and the often-cumbersome bureaucratic processes involved in curriculum reform, contribute to this stagnation.

- **Limited Engagement in International Collaborations:** The level of sustained, mutually beneficial, and impactful collaboration between Nigerian universities and their counterparts in other parts of the world remains comparatively low. This limited engagement restricts opportunities for collaborative research endeavours, valuable faculty and student exchange programmes that foster intercultural understanding, and the crucial sharing of best practices in innovative curriculum design and effective delivery methodologies. Factors contributing to this include funding limitations, a lack of established networks, and at times, a perceived lack of institutional support for pursuing international partnerships.
- **Inadequate and Fragmented Policy Frameworks:** A well-articulated, strategically focused, and adequately resourced national policy framework that explicitly supports, incentivises, and provides clear guidelines for curriculum internationalisation across all disciplines within Nigerian higher education, is often lacking. This absence can lead to a fragmented, inconsistent, and often ad-hoc approach to internationalisation efforts across different institutions, hindering systemic progress and preventing the development of a cohesive national strategy.
- **Significant Faculty Development Deficiencies:** Many academics within Nigerian universities may lack the specialised training, relevant international exposure, and pedagogical expertise required to effectively integrate diverse international perspectives, complex global issues, and crucial intercultural dimensions into their teaching practices and research endeavours. Opportunities for targeted professional development, specifically focused on the principles and practices of curriculum internationalisation, are often limited in scope, availability, and relevance to the specific needs of Nigerian academics.
- **Language Barriers and Insufficient Emphasis on Multilingualism:** While English serves as the official language of instruction within

Nigerian higher education, the rich linguistic diversity of Nigeria itself, and the increasing global recognition of the strategic importance of multilingualism in fostering effective international communication and collaboration, pose a significant challenge. The relative lack of emphasis on the strategic integration of multilingual education within academic curricula can inadvertently disadvantage Nigerian graduates as they navigate increasingly multilingual and multicultural international settings. Furthermore, the potential of leveraging Nigeria's indigenous languages in fostering intercultural understanding within the national context is often under-explored.

- **Constrained Resource Allocation and Inadequate Infrastructure:** Persistent financial limitations and the presence of inadequate physical and technological infrastructure within many Nigerian universities can severely hinder the effective implementation of meaningful internationalisation initiatives. This includes challenges in developing high-quality internationalised course materials, providing adequate support for student and faculty mobility programmes, and strategically adopting digital learning technologies that can facilitate global connectivity and access to international resources. The lack of consistent funding for internationalisation efforts makes long-term planning and implementation difficult.
- **Challenges in Ensuring Quality Assurance of Internationalised Curricula:** Guaranteeing the academic rigour, relevance, and overall quality of internationalised curricula necessitates the establishment and effective implementation of robust quality assurance mechanisms. Existing quality assurance frameworks within Nigeria may require significant adaptation and enhancement to effectively evaluate the specific international dimensions of academic programmes, ensuring that they meet both national and internationally recognised standards. The lack of specific metrics and evaluation criteria for internationalisation can lead to inconsistent quality and a lack of accountability.

A Comprehensive Strategic Framework for Advancing Curriculum Internationalisation in Nigerian Higher Education

To effectively address the multifaceted challenges outlined above and to foster a deep and meaningful integration of global perspectives into the fabric of Nigerian higher education curricula, a comprehensive, multi-pronged, and strategically aligned framework is urgently required:

1. **Formulation and Implementation of Robust National Policies and Guidelines:** The National Universities Commission (NUC), in collaboration with the Federal Ministry of Education and other relevant stakeholders, must take a proactive and leading role in formulating clear, comprehensive, and strategically focused national policies and overarching guidelines that explicitly prioritise, promote, and provide robust support for curriculum internationalisation across all academic disciplines within Nigerian higher education. These policies should articulate a clear vision for internationalisation, define measurable goals and objectives, and provide a roadmap for implementation at the institutional level. Furthermore, these national policies should incorporate tangible incentives for universities to actively engage in meaningful international collaborations, develop innovative joint degree programmes with international partners, and systematically integrate diverse global perspectives and intercultural competencies into the design and delivery of their curricula. The government, at both federal and state levels, should commit to allocating dedicated and sustainable financial resources to directly support curriculum internationalisation initiatives, including the provision of funding for targeted faculty development programmes, the facilitation of increased student and faculty mobility opportunities, and the development and acquisition of high-quality internationalised learning resources and digital infrastructure.
2. **Strategic and Sustained Investment in Faculty Development for Global Pedagogical Competence:** Nigerian universities must prioritise and invest significantly in the design and delivery of comprehensive and sustained faculty development programmes specifically focused on the principles, practices, and effective implementation of curriculum internationalisation. These programmes should equip academics across all disciplines with the essential skills, relevant knowledge, and

innovative pedagogical approaches. The skills and innovative pedagogical advantage of such programmes enable academics to:

- critically analyse and effectively integrate diverse international case studies, global examples, and comparative perspectives into their teaching and learning materials;
- develop advanced intercultural communication skills and cultivate inclusive and supportive cross-cultural learning environments within their classrooms;
- strategically utilize digital technologies and online platforms to connect with international peers, access global learning resources, and facilitate collaborative online learning experiences for their students; and
- design, develop, and deliver academic courses and programmes that are explicitly framed within a global context and that actively promote the development of global competencies among students.

Universities should actively promote and provide robust support for faculty exchange programmes with international partner institutions, as well as facilitate and fund participation in relevant international conferences, workshops, and seminars focused on curriculum internationalisation and global education. Mentorship programmes, pairing experienced internationalised faculty with those new to the process, can also be highly beneficial.

3. **Cultivating Strategic Global Partnerships and Fostering Transnational Education Initiatives:** Nigerian universities should adopt a proactive and strategic approach to identifying, cultivating, and sustaining meaningful and mutually beneficial partnerships with reputable international universities, leading research institutions, and relevant global organisations. These strategic partnerships should be designed to facilitate a range of collaborative activities, including:

- joint research projects that address global challenges, reciprocal faculty and student exchange programmes that promote intercultural understanding and academic enrichment;

- the collaborative development and delivery of joint degree programmes (transnational education initiatives) that enhance global recognition and provide students with international learning experiences; and
- the effective sharing of best practices in innovative curriculum design, pedagogical methodologies, and quality assurance processes.

Formal Memoranda of Understanding (MOUs) should be meticulously developed with clearly defined objectives, specific responsibilities for each partner institution, and robust mechanisms for ongoing monitoring, regular evaluation, and mutual accountability to ensure the success and sustainability of these collaborations. Exploring opportunities for joint supervision of postgraduate students and the co-publication of research findings can further strengthen these partnerships.

4. **Strategic Integration of Multilingual Education and Intercultural Competence Development:** Recognising the increasing importance of multilingualism in the globalised world and leveraging Nigeria's rich linguistic diversity, universities should strategically explore and implement effective strategies to promote multilingualism and the development of deep intercultural understanding among their students and faculty. This could involve offering a diverse range of elective courses in strategically important international languages, intentionally incorporating multilingual resources and perspectives into core course materials across various disciplines, and actively encouraging student engagement with diverse linguistic and cultural contexts through study abroad programmes, virtual exchange initiatives, and collaborative projects with international students. Universities should also recognise and strategically leverage the rich tapestry of indigenous languages within Nigeria itself as a valuable resource for fostering intercultural understanding and promoting a more inclusive and globally aware learning environment. Integrating cultural exchange activities, international film screenings, and guest lectures from international scholars can further enhance intercultural competence.
5. **Judicious Adoption and Effective Utilization of Digital and Multilingual Learning Content and Platforms:** Nigerian universities must strategically embrace and effectively leverage the transformative potential of digital technologies to significantly enhance curriculum internationalisation efforts. This includes:

investing in the development and robust utilization of user-friendly online learning platforms that provide seamless access to a wide array of high-quality global learning resources and facilitate meaningful connections and collaborative learning opportunities with international peers and experts;

- actively incorporating openly licensed educational resources (OERs) and other freely accessible internationalised learning content into academic curricula, ensuring their quality and relevance to the Nigerian context;
- providing adequate support and resources for the development and effective use of multilingual learning materials and resources that cater to diverse linguistic backgrounds and promote multilingual competence; and
- strategically implementing virtual exchange programmes and collaborative online international learning (COIL) initiatives to provide students with valuable international and intercultural experiences without the significant costs and logistical complexities associated with physical travel.

Ensuring equitable access to technology and providing adequate training for both faculty and students in the use of these digital tools are crucial for successful implementation.

6. **Systematic Curriculum Review and Fostering a Culture of Pedagogical Innovation:** Nigerian universities must establish robust and regular cycles of comprehensive curriculum review, specifically designed to identify strategic opportunities for meaningful internationalisation across all academic programmes. This review process should actively involve input and feedback from a diverse range of stakeholders, including international experts in relevant disciplines, successful alumni with significant international experience, and representatives from industries and organisations operating within the global marketplace. Universities should actively encourage and reward innovative approaches to curriculum design and pedagogical practices that explicitly embed global perspectives, cultivate essential intercultural competencies, and provide students with meaningful opportunities for international engagement and experiential learning. This could include the development of internationally focused case studies, simulations of global challenges, and collaborative projects with international student teams.

7. **Enhancing Opportunities for Meaningful Student and Faculty Mobility:** Nigerian universities should proactively promote and provide

robust support for both inbound and outbound student and faculty mobility programmes, recognising their crucial role in fostering intercultural understanding, academic enrichment, and the development of global networks. This includes providing adequate financial assistance in the form of scholarships and grants, streamlining administrative processes related to visa applications and academic recognition, and establishing clear and transparent credit transfer mechanisms to facilitate seamless academic integration. Concerted efforts should be made to cultivate a welcoming, inclusive, and supportive campus environment for international students and faculty members, providing them with the necessary academic, social, and cultural integration support. Establishing dedicated international student and scholar offices with well-trained staff is essential for providing effective support services.

8. **Strengthening and Adapting Quality Assurance Mechanisms for Internationalised Curricula:** Existing national and institutional quality assurance frameworks must be critically reviewed and strategically adapted to explicitly address and effectively evaluate the international dimensions of academic programmes. This includes developing specific indicators and benchmarks related to the quality and impact of international collaborations, the effective integration of diverse global perspectives into teaching and research activities, and the demonstrated international employability and global competence of graduates. External review processes should incorporate the expertise of individuals with significant international experience in curriculum development, quality assurance in international education, and the assessment of global learning outcomes. Regular monitoring and evaluation of internationalisation initiatives are crucial for ensuring their effectiveness and identifying areas for improvement.

Conclusion

The comprehensive internationalisation of curricula within Nigerian higher education is no longer a peripheral consideration, but a fundamental strategic imperative for universities aspiring to achieve and sustain global relevance, enhance their academic standing, and contribute meaningfully to the sustainable development of Nigeria in an increasingly interconnected world. While the Nigerian higher education sector faces a unique set of persistent

challenges in this endeavour, the potential benefits of cultivating globally competent and ethically engaged graduates, significantly enhancing institutional quality and international reputation, and fostering impactful international collaborations, are undeniably transformative. The comprehensive and multifaceted strategic framework articulated in this paper provides a detailed and actionable roadmap for Nigerian universities to effectively embrace the principles and practices of curriculum internationalization. The framework encompasses robust policy reforms, targeted faculty development, cultivation of strategic transnational partnerships, integration of multilingualism, effective adoption of digital technologies, systematic curriculum innovation, enhancement of mobility opportunities, and strengthening of quality assurance mechanisms, By proactively and strategically implementing these recommendations, the Nigerian higher education system can effectively bridge the existing gap between local and international academic standards, contribute significantly to the global knowledge economy, advancement of research. Most importantly, the recommendations will also empower the Nigerian higher education's graduates with the essential knowledge, sophisticated skills, ethical values, and crucial global competencies necessary to navigate the dynamic global landscape. They will also be able to contribute meaningfully, and thrive ethically, in an increasingly interconnected, complex, and dynamic global landscape, ultimately fostering sustainable development and progress for the nation and its people.

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CHAPTER TWENTY-SIX

The Role of Online Learning in Reducing Carbon Footprints and Enhancing Digital Sustainability in Global Education

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Abstract

Along with the digital transformation of global education, the concept of online learning has attracted more and more attention to the environmental side. This research focused on how online learning can be useful in minimising carbon footprints and promoting digital sustainability. It uses secondary data research methodology to synthesise knowledge that is based on academic publications, institutional reports, and case studies in determining the ecological and operational impact of e-learning. The results indicated that internet-based learning can significantly reduce greenhouse gases as it reduces commuting and decreases the use of physical infrastructure, as well as cutting down on paper. Besides, it helps to have energy-efficient learning environments and protect the reserves. Nevertheless, the problems of digital inequality and the environmental costs of digitisation infrastructures still exist. The research re-emphasises the relevance of inculcating environmentally sensitive and inclusive digital policies in educational systems. With proper behavioural alignment of online learning with global sustainable initiatives in the developing world, the education sector can make a valuable contribution to addressing climate change and advancing sustainability.

Keywords: Online Learning, Digital Sustainability, Carbon Footprint Reduction, E-Learning.

Introduction

Over the last 20 years, the educational landscape has experienced a tremendous change in the educational delivery system, which came as a result of the universality of digital technologies and the global events of the pandemic, including COVID-19. Educational organisations, such as primary schools, colleges, and even universities, have focused on online learning platforms to continue their work and improve access to education and its experience

regarding the evolution of learner needs (Bozkurt et al., 2020). This online shift has not just reshaped the ways of teaching, but it has also brought serious concerns about the sustainability of educational practice in a fast-warming planet. Traditional education has caused adverse effects to the environment historically, which have not been given attention. However, physical campuses use a lot of energy to heat, light, and air condition; emit carbon pollution due to their daily commutes; and use great amounts of paper as well as other consumable materials (Rodriguez & Pons, 2020). It is in this sense that online education provides an attractive alternative, which is more consistent with the aim of environmental sustainability. The conversion to a virtual environment enables institutions to curb the negative impact on the environment as well as save natural resources and help eliminate congestion in the city, particularly in cities with a high concentration of academic organisations (Leal Filho et al., 2022).

Carbon footprint is a general phenomenon that is used to describe the total amount of greenhouse gas (GHG) that is emitted by all of the human activities in terms of carbon dioxide equivalent (CO 2 e). In educational contexts, carbon footprints are the output of different sources: energy used in buildings, emissions during transportation, physical material utilized in teaching and learning, and procurement of the institutions (Roy et al., 2021). Indeed, educational establishments in the industrialised countries are the leading consumers of carbon emissions in the public sector, according to the UK Department for Education (DfE, 2022). Online education can help lower most of these emissions by removing the need to commute every day; by cutting down all the printed documents and lowering the costs of energy associated with infrastructure.

According to a study by Lantada et al. (2020) at Universitat Politica de Catalunya, the format of hybrid learning and remote education can minimise carbon-related emissions of institutions by up to 60%. The same was also reflected in the research done by Mendoza et al. (2019), as they reported the most considerable financial savings on resources that were used in universities implementing online-first techniques.

Although the overall reduction of emissions is one of the main advantages, online learning should be put under scrutiny of overall digital sustainability as well. This idea combines ecological, social and economic sustainability and digital technologies application. It supports the implementation of technology-

based solutions to learning, which should be energy-saving, but also equitable, inclusive, and accessible to various educational situations (Sterling & Thomas, 2021). The concept of digital sustainability is built on the belief that the applied educational technologies must promote long-term sustainable development goals (SDGs), in particular, quality education (SDG 4), climate action (SDG 13), and reduced inequalities (SDG 10) of sustainable development goals (UNESCO, 2021). This vision can be realised through the means of a long-term strategic plan and investments in elements of digital infrastructure, training of teachers, and design of inclusive content. Additionally, since carbon intensity of cloud computing and data centres keeps growing, sustainable design decisions, including the adoption of green hosting services or low-bandwidth platforms, are significantly more essential (Hughes et al., 2022). With the education moving to digital versions, more attention is drawn to its impact on the environment. This paper discusses how online training has reduced carbon impacts besides promoting digital sustainability in international education.

Review of Literature

An increased stream of empirical evidence supports online and blended learning in terms of environmental benefits. E-learning also helps to decrease the distance educated people travel; thus cutting down on the direct and indirect emissions of a traditional education system. As an illustration, Singh and Moe (2022) determined that virtual workshops that replaced face-to-face training programmes led to 80-percent decrease in travel-related emissions in a multinational NGO. Also, schools have an interesting opportunity to reduce their electricity rates substantially if they implement asynchronous online modules, where the server may be used in real-time and classrooms need not be lighted up. Furthermore, using digital textbooks and cloud-based collaborative programmes would decrease the number of printed works and, as such, protect forests and decrease water contamination in the production of paper and ink (Mendoza et al., 2019). These savings, though not easily quantified cumulatively, have an impact mostly when added up among the millions of learners all over the world.

Around the world, all nations have started using national education strategies to include digital sustainability. On the one hand, in Finland, the Ministry of Education and Culture has already launched the policies of school curriculum digitalisation that is highly focused on environmental literacy and embraces

sustainability (Ministry of Education and Culture, Finland, 2021). In a similar vein, the National Education Policy (NEP) 2020 in India refers to digital or online learning as a viable and flexible way to mitigate regional and economic inequalities (Ministry of Education, India, 2020). Digital sustainability has also been scaled at the international level. To cite a recent example, the UNESCO Global Education Coalition that was introduced at the time of the pandemic enabled transnational resource-sharing. It also supported the creation of sustainable digital learning environments, especially in the developing world (UNESCO, 2021). In Latin America, Brazil Universidade Federal de Santa Catarina provided a case study that demonstrated that digital inclusion programmes helped to expand access to a range of digital applications in addition to reducing energy consumption per student (Silva & Barbosa, 2021).

Although, online learning has got a lot of potentials, there are a number of obstacles to overcome to fully experience its staying power. The most evident challenge is the digital divide that contributes disproportionately to the students in the low-income and rural localities. The absence of access to equipment, fast internet, and assistance in coping with technology prevents engagement in the online educational process and increases inequalities of access to education (Bozkurt et al., 2020). Also, an increased usage of technology makes people worried about e-wastes and resource-thirsty data centres. International Energy Agency (IEA, 2021) documented that data centres and networks consume almost 1 percent of all energy in the world, and it will increase unless it is balanced with the help of the green technology. There is, therefore, a need for educational institutions to take account of the lifecycle effects of the devices and platforms deployed and this should be through the use of circular economy principals, which include reuse, recycling, and procurement in responsibility (Sterling & Thomas, 2021).

To maximise the environmental impacts of online education, a multiple-faceted approach is required and should include the criteria of technological efficiency, systemic policy-making, innovative pedagogical space, sustainability indexes tracking. Institutions have the option of implementing green certification schemes in digital education schemes, carrying out carbon audits, and rewarding low-carbon practices among the students and faculties. By incorporating Environmental, Social, and Governance (ESG) standards into the educational context (particularly higher education institutions), administrators have had a way to harmonise online learning with the concept of sustainability

(Roy et al., 2021). In addition, online learning needs to spread awareness of the environmental problems, fostering eco-consciousness in learners and ensuring that they are ready to contribute to global climate resistance.

The transition to online education has raised the whole spectrum of academic research that has focused on the potentials, which this new form of education can have on the environment. Through many studies, it has been concluded that e-learning significantly cuts down the emission of greenhouse gases (GHG) due to the avoidance or diminished concern of the daily commute and the utilization of physical infrastructure (Roy et al., 2021; Lantada et al., 2020). As a comparative study, Mendoza et al. (2019) observed that by replacing in-person lectures with the delivery of lectures on asynchronous online platforms, as much as 90 percent of energy consumption could be lowered per student. The authors cited the electricity, fuel, and resource saving as the highlights of the eco-efficiency of digital education.

Lantada et al. (2020) measured carbon emissions in a blended learning approach at one of the universities in Europe and identified that education delivery formats with minimum physical presence result in a lower ecological impact per academic hour. Similarly, Singh and Moe (2022) also analysed the virtual corporate training models and identified the fact that travel reductions led to 80 percent decreases in emissions. These researchers highlighted the climate benefits of distance learning, particularly when conducted at scale on the academic landscape. On top of carbon emissions, online education makes an impact into other forms of resource efficiency. Schools, which apply e-learning formats, use much fewer sheets of paper, physical education books and school equipment (Rodriguez & Pons, 2020). The Environmental Paper Network (2020) predicted that such an approach could cut the current level of deforestation related to the education industry by anywhere between 5 and 7 per cent every year. The submission of digital work and cloud-based collaboration also reduced waste and aided paperless administrative work by institutions.

There are challenges linked to cloud computing, however. Digital platforms that are operated by data centres also increase the world energy consumption, and Hughes et al. (2022) emphasised that there is a need to balance between technologically accessible and environmentally aware society. The results indicated a necessity in green data infrastructure and environmentally programmed software design into educational technology ecosystems. Digital

sustainability has been emerging as an important scholarly concept in the last few years when researchers and policymakers attempted to bring digital transformation into compliance with sustainable development. Digital sustainability, according to Sterling and Thomas (2021), refers to the ability of digital technologies to enhance long-term ecological stability alongside equity, efficiency, and resiliency in education systems. This definition brings the environmental discourse to the social-economical spheres and that requires an interdisciplinary methodology. Leal Filho et al. (2022 developed a conceptual framework that integrates the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 10 (Reduced Inequalities), SDG 13 (Climate Action) and digital education practices. They provided that online education should not only address the issue of energy efficiency, but inclusiveness and scalability should also guide the global sustainability efforts.

The environmental side of digital education becomes ever more accentuated in policy-relevant literature. The Department for Education of the UK (2022) has developed a plan of fulfilling the goal of education institutions going carbon-neutral with online learning in the forefront. In the same line, the Indian National Education Policy (NEP) 2020 focuses on digital growth, as one of the mechanisms of attaining accessibility and sustainability in the education delivery sector. UNESCO (2021) released a roadmap to education on sustainable development (ESD), which supported the use of digital approaches to develop international citizens, upbringing their awareness of the green environment. The roadmap focuses on collaboration through digital platforms, which minimise consumption versus knowledge sharing. Furthermore, the European Commission (2022) has implemented policies in which education technology vendors are required to engage in green computing facilities, and this is a clear indication that sustainability and digital governance are becoming similar.

Empirical case studies provide hard facts of the role of online learning in lessening ecological footprint in various geographical settings. Silva and Barbosa (2021) reported an example of a programme led by a university in Brazil, which offered access to solar-powered equipment and digital data to the marginalised students. Not only did this cut emissions, but it also enhanced digital equity. As an example of countries in the Nordic region, the Ministry of Education in Finland has initiated curriculum-level changes that prepare learners to become familiar with environmental literacy alongside the domain

of online platforms (Ministry of Education and Culture, Finland, 2021). These are the digital resources, which are configured to operate on low-energy servers and go in line with climate neutrality goals of the country. In Asia, blended learning has been tested in Chinese, Indian and South Korean universities, using energy audits to support carbon tracking systems. According to Roy et al. (2021), the incorporation of online modules in Indian universities during the pandemic resulted in decreased emissions caused by the use of electricity and transport by 35460 percent.

Summarising the literature that were reviewed in this regard brought to the fore various relevant themes. First, online learning has significant qualities of a low carbon footprint with minimised journeys and use of resources to a minimum, and energy-saving activities. Second, digital sustainability comes with a four-dimensional approach to the concept, which incorporates both economic and social viability and social justice with ecological objectives. Third, although the attempts of policy and institutional approaches appear encouraging, issues like the digital divide, e-waste, and power-hungry technologies entangle the picture of sustainability. Arising from all the themes is the fact that there are longitudinal, cross-sector and Global South-based study gaps that require completion. This review highlighted how positive design of sustainable systems of online education should be comprehensive and inclusive. Since digital learning has taken a foothold in world education and it is unlikely that it will fade away, it is important to make sure that it is sustainable (environmentally and socially) in a way to secure a sustainable future of education.

Research Gaps

Although the benefits of online education in terms of the environment and operations have been largely attributed in the literature, some of the major loopholes in these studies have not been clearly filled. The majority of studies adopted preliminary short-term and cross- sectional approach, which do not address the issue of the sustainability of online learning in the long run. Longitudinal studies that follow ecological and educational performances of digital learning on the long term are lacking as well. So, the question of whether the current environmental gains are long-lasting or merely a result of a short-term reaction, like the one caused by the COVID-19 pandemic, has become very difficult to answer. Besides, there is also an enduring imbalance in the literature with a central focus of the research done in higher education

institutions based in the technologically well-developed countries in the Global North. This distorts the concept of digital sustainability as well as the insights into how it may affect K-12 education or even in developing nations of Asia, Africa, and Latin America where the infrastructural, economical, and social limitations are rather different.

Moreover, more behavioural and social dimensions of sustainability are lack in the extant studies. Not many researchers think about the influence of learners' attitudes, digital skills, and mental well-being on the effectiveness of online education systems. Screen fatigue, motivation, and accessibility in remote settings are some of the issues that shape the sustainability of the digital platform, but they are hardly ever part of sustainability assessments. Finally, the empirical research on assessing how education policy and institutional strategies can support the objectives of sustainability through the digital learning is very weak. Despite available international frameworks, like the roadmap to sustainability in education of UNESCO, there are still no universally accepted standards and indicators of performance at institutional level to structure the implementation and measure progress. These gaps in the research raise the necessity of an international and elaborated, context-responsive study of the possibilities of online learning to actually promote environmental and digital sustainability in the global education systems.

Research Objectives

1. To analyse how online learning help in minimising carbon imprints in education sector in various geographical and institutional settings.
2. To assess the influence of online education on ensuring digital sustainability by paying attention to environmental efficiency, social inclusiveness, and infrastructure.
3. To create a unified framework, composed of environmental, pedagogical, and economic indicators, to evaluate the sustainability of digital education models on the global scale.

Research Methodology

The research approach used in this study was qualitative secondary data where the researcher attempted to investigate the environmental and sustainability aspect of online learning and focused specifically on the Indian education

system. The data were collected using a variety of reliable sources such as peer-reviewed journals articles, institutional reports, policy papers and case studies concerning e-learning practices and sustainability results. Specific focus was on the accuracy of data related to digital education programmes in order to put the discoveries into the socio-economic and technological reality. This practice helped in developing a holistic picture of how and at what level digital models of education may be made to be sustainable without discriminating access to various learners within the segment.

Data Analysis

This study examined the effect online learning has on reduction of carbon footprint and digital sustainability. The evaluation aimed at determining trends, patterns, and main insights concerning the ways online learning can lead to environmental efficiency and sustainable education process. It has four dimensions namely: (1) carbon emissions and energy use; (2) digital infrastructure and resource efficiency; (3) social inclusion and accessibility; and (4) institutional strategies and policy frameworks.

Energy Consumption and Carbon Emissions Reduction

The most noticeable area in which online learning has reduced carb on emissions is in the switching of physical classroom to the virtual classroom. Other national and international studies indicated that online learning would reduce commuting emissions to a great extent. To illustrate this, one of the TERI's (The Energy and Resources Institute, 2021) reports suggested that on the verge of the COVID-19 lockdown, the local transportation emissions dropped by 15-20 percent due to the closure of educational institutions. This decline was largely attributed to the increased popularity of the online learning platforms. A study carried by Singh and Moe (2022) examining virtual learning in South Asian institutions revealed that the substitution of direct training, workshops, and courses with web-based material pointed to an 80 percent reduction in emissions on travel, paperwork, and building operations. Such results indicated that the institutional implementation of e-learning did not only continue academic life but also provided a co-benefit impact on the environment.

Information Resources and Infrastructure Efficiency

Another impact is that online learning encourages the efficiency of resources because of the minimised use of physical limitations like paper, books and

paper assignments. The usage of paper decreased due to more use of online digital learning platforms. The move to paperless tasks, e-books and cloud storage did not only reduce pressure on deforestation due to paper production, but also led to cost savings in logistic and purchasing spheres. But this information also indicated the new environmental price of digital infrastructure, especially the growth in electricity consumption by servers and internet-connected devices. The International Energy Agency (IEA, 2021) referred to global data centres that already consumed almost 1 percent of all energy needs. However, there is certain progress with pilot projects of solar-powered employee education servers, making it seem that a green version of digital infrastructure is possible.

Social Inclusion and Digital Equity

Online learning transition has been associated with complicated equity and inclusion effects, particularly among rural and low-income earners population. The Annual Status of Education Report (ASER, 2021) also provided that almost 37% of students in urban region did not have smartphones or access to the Internet during the pandemic, a factor that reduced their chances of getting involved in remote learning. This is especially a key obstacle to the vision of digital sustainability since it leaves a huge segment of learners out of the green advantages of online learning. However, the usage of radio, community centres, and solar charged tab, had worked successfully, especially in far tribal regions in some states. Such initiatives showed how digital sustainability can become socially open to solutions based on infrastructure realities.

Institutional and Policy-Level Sustainability Strategies

The study also pointed at the rising policy focus on linking education to environmental sustainability. It is time to consider technology within any educational process and enhance overall behaviour in all educational stages towards contributing to the environment and preserving the climate. In addition, sustainability systems, applied in institutions, are starting to embrace digital sustainability measures e.g., the Green Campus Movement. Some institutions and universities are making efforts to monitor and report on the sustainability outcomes of their digital education practice. These involve carbon audits of ICT business, open-source platforms to minimise licensing waste and recycling e-waste by students. Even though these practices remain rather narrow in scope, they are open to the possibility of increasing awareness

and institutional interest in creating a new balance between technological creativity and environmental responsibility.

Summary

Theme	**Insights**
Carbon Emissions	Online education significantly reduces transportation and infrastructure-related carbon output.
Resource Efficiency	Shift to digital tools leads to major savings in paper and printing-related energy consumption.
Infrastructure Challenges	Data centres and device usage increase energy demand, requiring renewable integration.
Social Inclusion	Rural and low-income students face barriers; hybrid and offline models help bridge access gaps.
Institutional Responses	Some universities and policies have started integrating sustainability into digital strategies.

Online learning, therefore, provides significant opportunities in terms of diminishing the carbon footprint of the education sector and developing digital sustainability. Nevertheless, these advantages are not equally distributed, but they depend on the availability of digitalisation, infrastructure preparedness, and institutional sustainability dedication. The different cases prove the potential and the shortcoming of digital learning as a sustainability practice. Although the carbon saving and the paper-saving can be easily identified, difficulties regarding the energy-intensive infrastructure and the social inequality have to be eliminated by means of the inclusive policies and the green technological innovation. It can be considered an essential source of basis in creating an overall and context relative framework to govern sustainable digital education in the world.

Major Findings

The results of this study are subdivided according to the research purposes.

Carbon emissions decreased considerably because of online learning.

Among the most important results of this study is that online education leads to significant reductions in carbon footprint of the education sector. The digital

platforms can easily replace the physical attendance in the classroom and, consequently, significantly reducing the number of transportation-related emissions, energy spent on campus facilities, and dependence on paper-based resources. Many universities and educational institutions case studies demonstrated a significant reduction in emission during online mode of learning during COVID-19 pandemic. This decrease was as a result of the reduced travel of students and faculty members, air-conditioned building occupancy and physical infrastructure use. Such results are consistent with the reported developments of trends globally and in other studies on the same topic, proving the ecological benefit of virtual learning environment.

Less Resource Consumption Improves Sustainability of Operation

Besides less carbon emission, online education has resulted in operational sustainability in the educational processes since there is more efficient use of resources. The fact that digital textbooks, e-assessments and collaboration tools can be used extensively reduces the number of papers, printing and even physical storing needs. Institutions learning management systems (LMS) have facilitated the shift to near-paperless mode of study by thousands of students and faculty members. The shift does not only help to conserve the environment, it also cuts on the costs of running operations, thus helping the economic aspect of sustainability. But this is only when institutions have strong digital platforms and the pupils can access an acceptable number of gadgets and internet services.

Digital Infrastructure is Costly to the Environment in Two Ways

Although digital learning alleviates the conventional environmental stressors, this research concluded that digital learning actually estimates novel types of carbon-intensity- the energy consumption of information centres, server farms, and manufacture and disposal of electronic devices. Such expenses are not always shown in institutional accounts. Online learning can be indirectly related to carbon emissions since it requires a lot of server farms supported by electricity powered by conventional power grids. Also, the increased amount of e-waste, because of high device replacement cycles and an absence of official e-waste recycling regulations in schools, contribute to environmental pressure. Therefore, online learning sustainability depends on environmental factors, which have to be complemented by green buying, energy-efficient coding and renewable energy sources usage.

Online Learning has Digital Divide Limit Equitable Sustainability

The unfair availability of digital resources is another important discovery. This has posed a big challenge to the realisation of possible digital sustainability universally. The leaners in the urban and wealthy population enjoy smooth online learning experience, but the leaners in the rural places and marginalised regions are impeded by poor internet access, absence of digital gadgets and low digital literacy levels. Such inequalities negate the diversity of digital learning and make the environmental advantages of online teaching available to a small population group. Students in most cases turned to printed study references or offline media, thus reducing the carbon saving that was to be achieved through digitization.

Behavioural and Psychological Sustainability is Usually Neglected

The research concluded that online learning contributes to the environmental sustainability, but it does not usually contribute to psychological and behavioural well-being, which are critically important part of the sustainable education. The concern among students and teachers includes high screen time, minimal peer interaction, and digital fatigue, especially when students are required to be online over prolonged durations. These factors have adverse impact on student engagement, motivation, and retention and look at the viability of long-term online education models in a negative light. Since sustainability is ecological as well as social and psychological, these results indicated that any digital learning strategies should involve the application of wellness design, flexible and dynamic schedules, and interactive teaching methods to create modalities that elicit resiliency among the learners.

The Policy initiatives are progressive but have no measurable sustainability metrics.

Under National Education Policy (NEP) 2020, the Indian government has introduced various digital education promotion programmes. SWAYAM, e-PG Pathshala, Virtual Labs and many other several initiatives are good towards scalable and sustainable digital education. Nevertheless, the research revealed that there is few institutional hybridisation of sustainability indicators, e.g., the number of carbon emissions saved, the amount of paper use avoided, or energy savings due to digital transition, etc. Such a gap is a drawback in terms of the strategies and openness needed to track the progress towards sustainability objectives.

The Need of Integrated Frameworks to Evaluate Sustainability of Digital Education

The last important conclusion is that the extant literature and institutional activities do not have a composite framework in terms of which the sustainability of digital education, environmentally, pedagogically and economically, is determined comprehensively. The majority of literature that exists concentrates on a single variable of environmental without considering the dynamics of other variables such as digital inclusion, quality learning, and economic efficiency. It requires a multidimensional model, which would allow policymakers and educators alike, to make informed decisions regarding the long-term viability of online education. Examples of such indicators to be included in such a model include carbon saving per student, levels of digital engagement, an analysis of infrastructure lifecycles, and socio-economic accessibility indicators.

Summary of Major Findings

Key Focus Area	Major Findings
Carbon Emissions	Online learning reduces carbon footprints through less commuting, facility usage, and paper consumption
Resource Use and Cost	E-learning promotes operational efficiency and cost reduction through digital resources and tools
Digital Infrastructure	Environmental costs of data centres and e-waste must be addressed to sustain long-term digital benefits
Digital Equity	Internet and device access gaps in rural India limit the inclusive sustainability of online learning
Student Well-being	Psychological fatigue and reduced engagement are barriers to behavioural sustainability in digital formats
Policy and Monitoring	Lack of carbon audits, benchmarks, and institutional metrics restrict measurement of sustainability progress

Framework Development	Need for a comprehensive sustainability assessment model covering environmental, social, and educational dimensions

Conclusion

This study has addressed the topic on how online learning minimises carbon footprints and increases digital sustainability in both the education system. The study offers substantial evidence that online learning can potentially reduce the negative environmental impact of the usual learning systems to a considerably high degree. Online platforms can radically reduce the carbon footprint related to the traditional system of education by minimising transportation to schools and workplaces by both students and faculty, and by reducing the physical infrastructure required to access learning resources as well as promoting the use of digital learning resources. The advantages of online learning, however, do not come automatically without some other drawbacks. The energy consumption of data centres as well as the emerging hazard of e-waste and the disparity in the access to digital activity are sustainability issues of real concern. The psychological issue, arising from online learning, is also a concern. The psychological issue include digital fatigue, less social interaction, and the stress caused by the level of screen-time exposure, all indicating that digital education needs an upgrade to a holistic level culminating into learner-focused education. The results of this study supported the idea for institutions and policymakers pursuing a comprehensive and site-specific approach to sustainability. Sustainability in education must be defined not only through carbon reduction levels, but also through inclusive access and sustainability as well as well-being of learners. In the absence of such multidimensional approach, online learning can lead to the duplication of some of the structural inefficiencies of conventional learning, or even lead to an increase in similar inefficiencies.

Future Implications

This research is significant to the policymakers and all educational institutions. It is also beneficial to the global sustainability agendas. Specifically, the study contributes to:

Development of Policy and its Monitoring

Regulatory bodies of education and governments must work on generating standard frameworks and sustainability indicators that pertain to digital education. This should incorporate periodic carbon audit, energy performance rating of learning platforms and specific information on green procurement and recycling of e-wastes.

Institutional Capacity Development

Sustainability needs to be addressed in the strategic planning of educational institutions, which should consider the introduction of special sustainability units, faculty training programmes on green digital practices, and the involvement of students in environmental activities on campus associated with digital learning.

Combination of Well-being Metrics

The design elements of future models of online learning need to consider the learner wellness, offering such features as screen-time control options, blending interaction opportunities, and adaptive learning environments. This will allow students to coordinate pace and format according to their feedback.

Global Collaboration

Since digital education is of transnational character, international collaboration will play a key role. Common frameworks, research alliances, and lasting technology alliances can be used to create scalable, equitable and environment friendly world education ecosystems.

Limitations of the Study

Although this study presented helpful insights into the extent to which online learning influenced the reduction of carbon footprints. The study was based on secondary data. Therefore, the results of the study depended on the extent of the reliability of the institutional reports and policy documents that were consulted. This study was not empirical; it did not gather primary data to measure the emissions in real-time, or statistically model the indicators of sustainability. Future study on this issue must, therefore, adopt empirical approach, using survey, lifecycle carbon analysis, or mixed methodological strategy. Besides, the analysis in this study was essentially specific to a country and not applicable to all countries.

Even with these limitations, the work provided a vigorous conceptual basis on future study and policy formulation on the attitude alignment of online education with the goals of sustainability.

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CHAPTER TWENTY-SEVEN

A Critical Review of Ethical Issues in STEM Teacher Education in Nigeria

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Abstract

In an era where technological and scientific advancements are pivotal to national development, this study examined the state of STEM (Science, Technology, Engineering, and Mathematics) education in Nigeria. It aimed to dissect the complexities, challenges, and opportunities within this educational sector, particularly in the context of global educational trends and national developmental imperatives. The study reviewed ethical issues in STEM teacher education in Nigeria. It clarified the concepts of ethics, norms, and what constitutes STEM Teacher Education. The study concluded that, beyond professional ethics, STEM teachers also need grounding in ethical theories and moral thinking skills. The study advocated for the inclusion of core courses on ethical theories and moral thinking skills into the STEM teacher education curriculum in Nigeria.

Keywords: Education, Ethics, Ethical dilemma, STEM, Teacher education.

Introduction

The trajectory of Science, Technology, Engineering, and Mathematics (STEM) education in Nigeria has been a gradual process, marked by some challenges and opportunities. Arising from a global acknowledgement of the significance of the STEM field, and despite the progress made, STEM education in Nigeria still faces numerous challenges, including inadequate funding, unstable education policies, and a lack of adequate support (Agboola, 2021).

The government's acknowledgement of the importance of STEM fields led to the founding of several federal universities specialising in science and technology, with a specific focus on enhancing STEM teaching and learning. These institutions marked the beginning of a structured approach to STEM education in Nigeria, focusing on creating a skilled workforce capable of driving technological advancement and innovation. Despite the government's

investment in STEM education, the sector has struggled with a multitude of challenges, including inadequate resources, insufficient infrastructure, and a shortage of qualified educators. Agboola (2021) identified key challenges, including poverty, underfunded schools, untrained teachers, and lack of educational resources. These numerous significant challenges pose a threat to the successful implementation, growth, and sustainability of STEM education. Despite the efforts to promote STEM education, women and girls remain significantly underrepresented in these fields, with less than 30% of STEM researcher worldwide being women, and only around 35% of students enrolled in STEM-related higher education were female.

Tim (2017 noted that mankind is arguably the most dominant and intelligent species on earth with the most complex social behaviours. Ethics, according to Frolov (1984), is a theoretical field of study concerned with the studies of morality, which emerged during the early days of the slave-owning society. It emerged from the spontaneous moral consciousness of society. Peter (2020) noted that ethics is a branch of philosophy that deals with "what is morally good and bad as well as what is morally right and wrong". Ethics applies to theory or any system of moral values or principles. Ethics has helped in the categorisation of different values such as integrity, discipline and honesty. Ethics influences our individual behaviours and guides in making the right decision. It is an important concept that helps to regulate life and act of responsible behaviour. The importance of ethics in society, and in the field of education in particular, cannot be over-emphasised. Ethics in education are generally essential as they play a prominent role in the smooth running of the education industry. It sets the standards of what is acceptable and what is not acceptable in teaching and learning situations. The onus then lies on teachers to share the acceptable ethics during their training to students to guide their daily conducts in society.

Norms, on the other hand, refers to a set of standardised ways of behaviour and conduct in a society, community or organisation. It deals with appropriate societal standards of behaviour, the morals used in making value judgments by individuals and society in general. According to Young (2015), norms are:

> ...patterns of behaviour that are self-enforcing within a group: Everyone conforms, everyone is expected to conform, and everyone wants to conform when they expect everyone else to conform. Social norms are often

> sustained by multiple mechanisms, including a desire to coordinate, fear of being sanctioned, signalling membership in a group, or simply following the lead of others.

STEM Teacher Education can be conceptualised as comprehensive programmes which consist of pedagogical theory, disciplinary knowledge, teaching, and professional skills designed to produce professionally competent, efficient and effective teachers in the fields of Sciences, Technology, Engineering, and Mathematics. In general, teacher education is a specialised professional programme designed for prospective and in-service teachers to acquire knowledge, skills and attitudes necessary to make them efficient and effective facilitators of learning. (Osuji 2009).

Ethical Standards for STEM Teachers in Nigeria

The mandate of the education industry extends beyond the production of literate citizens, and the required manpower for sustainable national development. It also includes producing morally upright citizen for the common good of society. Indeed, teachers are often regarded as "Moral Compass" for students in view of their expected significant roles in moral upbringing of students. Hence, ethical issues and social norms take centre stage in the field of teacher education. Since teachers can teach only what they know, pre-service and in-service teachers are equipped with the required ethical standards and social norms through teacher education and teacher professional development programme.

Ethical standard in teacher education refers to code of conducts that regulate the behaviour and relationship of teachers with students, colleagues, school administration, parents as well as society. As observed by Rasmi, Lakshmipriya and Santosh (2014), ethical standards in teacher education deals with basic principles, procedures and behaviour patterns which is based on dedication and commitments to core values that are deeply rooted in education system. The Teacher Registration Council of Nigeria (TRCN) (2013) rightly noted that:

> No profession can stand without clearly defined "dos" and "don'ts" representing the core values that the profession shares and holds tenaciously. Teaching in particular deals with the moulding of character of humanity and itself must

> rest on a set of solid, tested and proven ethical framework that guarantees the very best atmosphere and trust in the teaching-learning process.

In keeping with international best practices and ethical standards in teaching profession, teacher education programmes mandatorily equips both pre-service and in-service-STEM teachers in Nigeria with professional ethics and norms. These professional ethics and norms otherwise known as teachers' code of conduct, which teachers are obliged to adhere to as spelt out by the TRCN (2013), are as follows:

- **Respect:** Teachers are obliged to respect each other in all circumstances irrespective of their cadre and must also assist each other to attain highest professional goals.
- **Symbiotic relationship**: All teachers are under obligation to establish symbiotic relationship with their colleagues for mutual benefits and uplifting the profession to a lofty height.
- **Responsibility:** Senior teachers are expected to display a high sense of responsibility and self-respect and take up the responsibility of bringing up junior colleagues professionally. Junior colleagues are under obligation to also respect their senior during formal and non-formal interactions; and must exhibit readiness to learn from them.
- **Loyalty:** Teachers are expected to exhibit a high sense of loyalty and co-operate with professional colleagues to enhance the achievement of professional goals.
- **Integrity**: Teachers are under obligation to display honesty, be trustworthy, and respect persons and property.
- **Discrimination:** Teachers are expected to have zero tolerance to discrimination on the basis of, religion, culture, race, gender, and so forth. They are, hence, obliged to relate equally with every person.
- **Defamation of colleagues:** In all circumstances, teachers are prohibited from making derogatory remarks about their colleagues; and should not lower each other's integrity.

- **Touting:** Teachers are prohibited from depriving their colleagues of clients and learners through misinformation, or any other unethical means.
- **Canvassing**: Teachers are forbidden to gain undue advantage over their colleagues by advertising themselves that they possess extra-ordinary knowledge and skills that they do not actually have.
- **Team work:** Whenever the need arises, teachers are expected to work as a team and equally seek for assistance from colleagues when undertaking tasks beyond their professional ability.
- **Plagiarism:** Teachers are under obligation to adhere very strictly to copyright laws and regulations. They are obliged to recognise the intellectual contributions of colleagues by refraining from all forms of plagiarism.

In addition to the forgoing ethics, guiding teacher's relationships with colleagues, there are also ethical standards that guide the relationship between teachers and students as summarised below:

- **Learner's right and dignity:** Teachers are required to respect the learner's right and dignity irrespective of their gender, race, religion, tribe, colour, physical characteristics, place of origin, age, and so forth.
- **Responsibility for educational programmes**: Teachers are required to professionally discharge their duties as facilitators of learning diligently.
- **Empathy**: Teachers are obliged to understand and share the feelings and circumstances of their students at all times.
- **Confidentiality:** Teachers are under obligation not to divulge students' confidential information except in the interest of the learner, parents/guardians, public and when required by law.
- **Fair remuneration:** Teachers are not expected to collect gratifications, bribes or any money for services already paid for by the employer.
- **Sexual misconduct and related abuse of office**: Teachers are prohibited from using their position to sexually harass, blackmail or intimidate their students. They are equally prohibited from promoting,

aiding and abetting sexual misconduct, drug addiction and trafficking, cultism, human trafficking among other criminal conducts.

- **Examination malpractice:** Teachers are prohibited from aiding and abetting examination malpractice by students.
- **Patronage of illegal learners' groups:** Teachers are required to refrain from patronising illegal and immoral student groups such as secrete cults, gay and lesbian.
- **Role model:** Teachers are obliged to serve as good role model to learners in their daily conducts such as decency in speech, mannerism, discipline, dressing and discharge of their duties.
- **Corrupt practice:** Teachers are prohibited from engaging in any form of corrupt practices such as asking or receiving gifts, gratification for themselves or for their colleagues.
- **Corporal punishment:** Teachers are forbidden to administer corporal punishment on their students without the permission of the school authority.
- **Discipline**: Teachers are to ensure that students behave in a civil and disciplined manner.
- **Ideological influence:** Teachers are prohibited from imposing or spreading their ideologies among learners.

There are also ethical standards that guide the relationships between the teachers and their employer, parents, and the pubic among other stakeholders. For instance, teachers are obliged to respect and provide relevant information about students and school to parents; take active parts in parent-teacher association. They are prohibited from taking gifts, favours, and hospitality from parents to avoid showing favouritism to any student. They are obliged to respect agreement between their union and employers, fulfil their contractual agreements with their employer and perform only tasks within their professional training (TRCN 2013).

Ethical Component of STEM

In addition to the forgoing ethical standards and norms, there are also, ethical standards that guide the daily activities of the scientific community such as curiosity, honesty, that constitute the ethical component of the structure of

science. According to Abimbola (2013), every STEM teacher should be conscious of these ethical standards, teach and exhibit them as professionals. They include but not limited to the following:

- **Seeking Relationship among Data:** Scientists should seek for relationship among data and formulate generalisation in form of concepts, laws and theories.
- **Anti-authoritarianism:** No scientist or group of scientists is allowed to enforce strict obedience to their authority at the expense of personal freedom of other scientists to conduct their research. Authority lies in the logic of man, data from nature, and the force of the scientific community.
- **Positive Approach to Failure:** Scientists should regard every failed attempt as an indication that there is a better way of doing it. The lesson from failure is that one way of not doing the same thing has been learnt. Scientists, therefore, should not become moody due to failure during experimentation.
- **Objectivity**: All scientists are under obligation to willingly consider many sides of an issue without any form of prejudice.
- **Open-mindedness:** Scientists are obliged to always willingly be receptive to new information or idea and examine all planned or unplanted information.
- **Commitment to the Goals of Science:** The goal of science is the formulation of relatively small number of basic concepts to explain natural phenomena.
- **Suspension of Judgments**: Scientists are obliged to always willingly suspend judgments in the absence of all necessary facts/date. Conclusions must be delayed until necessary facts are available.
- **Curiosity:** Scientists should be very curious, desiring to know more and thus must not be satisfied with the status quo.
- **Accurate Observation:** It is an obligation for every scientist to ensure that observations are accurately made and recorded. Although observations are theory–laden, it must be free from bias of the observer as far as possible.

- **Morality:** In the field of pure sciences, scientists are not under obligation to be concerned with the moral implications of their research work. However, in the field of applied sciences, scientists should consider the moral implications of their studies.
- **Communication:** Scientists should make their findings known to the scientific community.
- **Scepticism**: Scientists are to willingly question the status quo by maintaining some degree of a doubting attitude (Abimbola, 2013).

Unlike the teachers' code of conduct that features prominently in a compulsory course, (EDU 111: Introduction to Teaching Profession) in the teacher education curriculum in Nigerian universities, the ethical component of science does not have the same status.

Ethical Issues and Dilemmas Facing STEM Teachers

STEM teachers often encounter conflicting interests in dealing with ethical issues when discharging their responsibilities. For instance, a teacher may be mandated by the principal to teach a subject other than his/her field of specialisation. Unscrupulous school management sometimes equally engages teachers to aid and abet examination malpractices (WAEC, 2020) or to collect illegal financial charges. Sometimes, the school principal may mandate teachers to give preferential treatment to student(s) due to intense pressure from influential parents. Similarly, a teacher may be aware of close friend(s) among his/her colleagues that covertly violates ethical standards such as trading mark for sex, and falsification of grades. There are also situation where student(s), out of frustrations, act provocatively to embarrass the teacher in the class. These and many more similar scenarios abound in schools, posing ethical dilemmas for teachers on daily basis. Teachers are expected to resolve these ethical issues appropriately without jeopardising their job and professional standards.

Teachers need more than mere familiarity with professional code of conduct to resolve these ethical challenges. The understanding of ethical dilemmas and how to resolve them adequately can be achieved by the application of ethical theories and moral thinking skills such as the Four Component Model of Moral Maturity propounded by Rest and Narvaez (1994). When faced with ethical dilemmas there is a tendency to rely on the four-component model to resolve

the dilemmas. Three levels of moral maturity in resolving ethical dilemmas are recognised under the model as follow:

a- The personal interest level: At this most basic level of moral maturity, dilemmas are resolved based on the direct advantage to the person under focus. There is no consideration of the impact of one's conduct on others; rather, emphasis is on doing what is considered to be the best for oneself, family and friends' approval. The need to serve one's interest is paramount at this level.

b- The maintaining norms level: Resolution of dilemmas at this next level is on the basis of maintaining the existing legal system, rules, societal and professional norms. Conducts are considered to be right as long as it contributes to profession, group or society in general. Laws are strictly adhered to except in few exceptional cases.

c- The post-conventional Level: This is the peak of moral maturity. Resolutions of ethical dilemmas are on the basis of general agreement through consensus such as majority vote, and appeal to moral principles such as adherence to due process and recognition of basic rights. The paramount focus is to uphold basic rights, societal values, and laws, even when they conflict with the rules and laws of the group.

Applying these three moral maturity levels to resolve ethical dilemmas in schools is not as easy as it seems to be. Naturally, teachers are sensitive about the ethical implications of their relationship with colleagues, students and other stakeholders. The three levels of moral maturity are thus a useful framework to address ethical dilemmas (Jacques, 2013). Ethical dilemmas calls for meaningful understanding of moral theories and their applications in real life situations by teachers. However, moral theories as a compulsory course are yet to be integrated into STEM teacher education in Nigeria.

Scientific and Technological Advancements do also raise ethical issues that STEM teachers have to respond to in the class. For instance, English (2019) reported that Chinese scientists are already producing 'designer babies' because advancements in genetics now enables scientists to edit human genome by altering the DNA sequences and change how genes function to prevent the spread of genetic diseases. This implies that scientists can now select and design the genetic qualities of a child to produce 'designer babies'. The long-time effects of this practice are unknown, and it calls into question

the definition human. Similarly, the trial of drugs and consumer products, such as cosmetics in animal, places the suffering of human over the sufferings of animals. While this may sound appropriate in cases of production of drugs to improve human health, it is a moral burden to subject animals to sufferings just to produce cosmetics (English, 2019). Experiments on human embryo and stem cell also raise ethical issues as they violate human dignity. Advancements in engineering have led to the evolution of autonomous machine such as driverless cars and killer drones. Autonomous machines work without human control and can take decision independent of human interference. The moral question here is: who is to be held accountable for the actions taken by these autonomous machines? (University of Notre Dame 2012).

STEM teachers are required to explain and discuss recent developments in their respective disciplines during class lessons. Hence, they have to be adequately prepared to address ethical issues that arose from such advancements with their students. To achieve this, STEM teachers need adequate grounding in ethical theories and moral thinking skills apart from keeping abreast with ethical issue related to the advancements in their field.

Conclusion

STEM teachers are expected to serve as moral compass in society. To this end, teacher education programme in Nigeria equipped them with professional ethical standards, which is also known as teachers' code of conduct. A society devoid of ethical conducts is inconceivable because individuals react differently to moral values and strict adherence to ethical standards is easier said than done. In discharging their responsibilities, STEM teachers often encounter ethical dilemmas almost on a daily basis. There seems to be no evidence in literature that teacher education programme in Nigeria equip STEM teachers with the ethical theories and moral thinking skills required to resolve ethical dilemmas. Similarly, the ethical component of the structure of science is yet to find a prominent place in STEM teacher education programme in Nigeria. STEM teachers obviously need beyond professional code of conduct; they also need grounding in ethical theories and moral thinking skills to address ethical dilemmas and issues in science and technology.

Recommendations

- The curriculum of STEM teacher education in Nigeria should be expanded to include course(s) on ethical theories and moral thinking

skills so as to enable teachers to adequately address ethical dilemmas they encounter when discharging their duties.

- The introduction of a course on STEM and Ethics should equally be integrated into the STEM teacher education programme.
- Teacher education institutions should place more emphasis on the ethical / moral conducts of STEM teachers right from the time they are admitted into teacher education programme.
- STEM teachers must always be conscious of their role not only as facilitators of learning but also as moral compass.
- Textbook authors should include ethical issues in teacher education, and in STEM textbooks.
- The Teachers' Registration Council of Nigeria, Science Teachers' Association of Nigeria, Mathematics Association of Nigeria, and Science Association of Nigeria should regularly keep teachers abreast of ethical issues in STEM through regular workshops and conferences.

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CHAPTER TWENTY-EIGHT

Internationalisation of Higher Education in South Africa: A Qualitative Case Study

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Abstract

Internationalisation of higher education has become a global trend, with African universities increasingly engaging in cross-border collaborations, student and faculty mobility, and curriculum internationalisation. Notable among the African countries pursuing rigorous internationalisation is South Africa, which has developed comprehensive policy frameworks aimed at addressing past inequalities and aligning with democratic values. It is against this background that this study examined the opportunities for internationalisation in higher institutions. This study adopted a qualitative research design using the case study approach. The purposive sampling technique was adopted to select academics of different nationalities with tenured appointments in South African universities. Data, which were collected using interviews and documentary analysis, were analysed using thematic analysis. Findings from the study revealed enhanced academic quality and curriculum development, increased research collaboration and knowledge exchange, faculty and student mobility, and economic and institutional growth as some of the opportunities arising from internationalisation and collaboration. The challenges identified included funding constraints and economic barriers, unfriendly policy and regulations, limited institutional capacity, geopolitical and safety concerns and brain drain. This study concluded that, as a leader in Africa's internationalisation of higher education, South Africa presents numerous opportunities for scholarly cooperation, economic development, and cross-cultural interaction. It is recommended that South Africa support the growth of higher education across Africa, among other initiatives.

Keywords: Internationalisation, Higher education, African universities, Globalisation.

Introduction

The internationalisation of higher education in Africa has been a growing trend, driven by globalization, technological advancements, and a desire for improved educational quality and competitiveness while emerging as a pivotal force in shaping academic institutions worldwide. This process involves the cross-border exchange of students, faculty, curricula, research collaborations, and institutional partnerships. The internationalisation of higher education has become a global trend, with countries seeking to enhance their educational systems through cross-border collaborations, student mobility, and academic exchange programs. African universities want to increase their worldwide visibility and competitiveness as globalisation continues to integrate economies, cultures, and knowledge systems. Increased staff and student mobility, cross-border cooperation, the use of global curricula, and involvement in worldwide research networks are all part of this dynamic (Shen et al., 2022). In Africa, internationalisation presents an opportunity to bridge knowledge gaps, improve academic standards, and foster global competitiveness. The growing need for high-quality instruction and research cooperation is one of the main forces behind internationalisation in African higher education. Cross-border knowledge exchange has become necessary as a result of globalisation, leading African universities to look for collaborations with organisations in North America, Europe, and Asia. Additionally, internationalisation fosters cultural exchange, equipping students with global competencies essential for navigating international labour markets. These collaborations facilitate student and faculty mobility, joint research projects, and curriculum harmonisation, thereby enhancing the global standing of African universities (Suntharalingam, 2024).

One of the key opportunities in the internationalisation of higher education in Africa is the potential for knowledge transfer and skill development (Moshtari & Safarpour, 2024). By partnering with global institutions, African universities can benefit from exchange programmes, faculty collaborations, and joint research initiatives while solving the problem of educational inequalities (Jowi, 2024). These partnerships enhance academic standards, expose students and faculty to diverse perspectives, and contribute to institutional capacity building. Moreover, international collaborations facilitate access to cutting-edge research and technological advancements that may otherwise be inaccessible due to financial and infrastructural constraints (Jowi, 2024). Private sector

engagement and public-private partnerships (PPPs) also present significant opportunities for the internationalisation of African higher education. By collaborating with industries and multinational corporations, universities can secure funding for research, develop industry-aligned curricula, and facilitate internships and job placements for graduates. Such partnerships can enhance the employability of African students while ensuring that higher education institutions remain relevant to evolving global economic needs (de Wit & Altbach, 2020).

However, the continent grapples with constraints such as inadequate funding, regulatory barriers. The COVID-19 pandemic underscored the urgent need for digital transformation in higher education, as many African institutions struggled to transition to online learning models (Mugimu, 2022). Furthermore, the digital divide continues to be a major obstacle to internationalisation in African universities. While many institutions in developed countries have embraced digital learning and virtual collaboration, limited internet access and outdated technological infrastructure in Africa pose major challenges (Oladele, 2024). Higher education institutions in Africa frequently have asymmetrical relationships with their counterparts in the global north, which results in unfair collaborations and little local control (Molosi-France & Makoni, 2020). This problem is aggravated by the critical issue of brain drain, where talented students and academics migrate to institutions in developed countries in search of better opportunities. This phenomenon depletes local talent pools, weakening African universities' capacity to conduct cutting-edge research and provide quality education (Scholarworks & Osigbesan, 2021).

Language and cultural barriers also pose challenges to the internationalisation of higher education in Africa (Msomphora, 2025). While many African colleges use English, French, and Portuguese as their main languages of instruction; nonetheless, linguistic diversity across the continent can make regional and global cooperation more difficult. Additionally, Western-dominated academic frameworks often overlook indigenous knowledge systems, limiting Africa’s contribution to global scholarship. Addressing these challenges requires a more inclusive approach to internationalisation that values local knowledge systems while promoting multilingual competencies (Murove, 2018; Ndaipa et al., 2023).

Despite these hurdles, African countries should take proactive steps to enhance the internationalisation of their higher education sectors. Initiatives such as the

African Union's Continental Education Strategy for Africa (CESA) 2016–2025 aim to foster academic mobility, strengthen research networks, and harmonise higher education systems across the continent (African Union, 2016). Additionally, regional frameworks like the African Higher Education Harmonisation and Quality Assurance Initiative (HAQAA) seek to align academic standards with international benchmarks, thereby improving the global recognition of African degrees (de Wit & Altbach, 2021). There is a significant push towards intra-regional academic collaboration in Africa. This includes the establishment of agreements and cooperation within the Southern African Development Community (SADC) and other regional bodies to enhance academic mobility and curriculum internationalisation (Kabeya et al., 2022; Southern African Development Community (SADC), 2022). This initiative has attracted the European union collaboration (European Union, 2021); showing that South Africa, is one of the continent's leading higher education hubs. It is therefore not surprising that 6.5 per cent of the total number of enrolments in universities in the country are international students, which is a significant proportion of the student body as reported by the Council for Higher Education reported (Banda & Zungu, 2024). Furthermore, South Africa has created extensive policy frameworks to direct the internationalisation of higher education to remedy historical injustices and conform to democratic ideals. The reported statistics and policy effort provide a compelling case for this study. In the light of this, this study investigated the prospects for internationalisation in higher education and explored both the opportunities and challenges associated with internationalisation in South Africa.

Objectives of the Study

1. Examine the strategies of internationalisation of higher education in South Africa.
2. Determine the opportunities of internationalisation of higher education in South Africa.
3. Examine the challenges of internationalisation of higher education in South Africa.

Research Questions

1. What are the strategies of internationalisation of higher education in South Africa?

2. What are the opportunities of internationalisation of higher education in South Africa?
3. What are the challenges of internationalisation of higher education in South Africa?

Conceptual Framework

The conceptual framework for this study examined key themes on internationalisation of higher education in Africa, consisting of strategies, challenges and opportunities as shown in Figure 1.

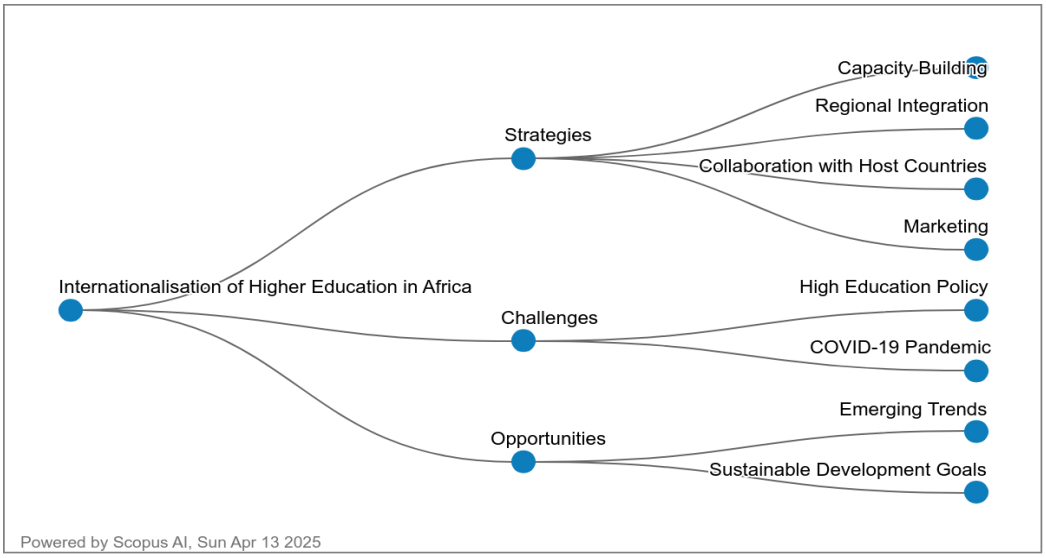


Figure 1: Conceptual Framework on Strategies, Challenges and Opportunities for Internationalisation in Africa

Internationalisation can be critical in assisting developing nations in overcoming issues like poverty, climate change, and educational disparities, as the need to push the frontiers of research to create new technologies and significant global projects grows. However, there is a dearth of research on the internationalisation of higher education in less developed African nations, even though higher education institutions have long experienced difficulties in this process, which have drawn scholarly attention in recent decades (Moshtari & Safarpou, 2024). While internationalisation is an emerging area, there are challenges in understanding the nitty-gritty of the concept. Some of these challenges are a lack of clear policies and inefficient organisational structures, which hinder internationalisation efforts (Kasenene, 2011; Pindado et al.,

2023). Other significant barriers are limited financial resources, inadequate infrastructure, and equipment shortages (Dirckinck-Holmfeld et al., 2023; Oladele, 2024). Weaknesses in scientific, skill, and language competencies, along with cultural differences, are also a major concern (Ram, 2020; Zickafoose et al., 2024), while the problem of brain drain constitutes another major challenge (Bhardwaj & Sharma, 2023). The loss of talent can impede economic growth and development, as this has become a major worry, especially for developing countries.

Despite these challenges, internationalisation offers many opportunities in the areas of developing clear policies and visions, planning for human resource development, and sustainable budgeting (Moshtari & Safarpou, 2024). National and international collaboration can aid the development of national policies and participation in international meetings to leverage scientific and economic capacities. Haley et al. (2024), however, stressed the possibility of universities in the wealthy and powerful global North using international cooperation more and more to become more competitive and market-oriented. Additionally, regional approaches and collaborations, such as the proposed continental credit accumulation and transfer system, can facilitate academic mobility and curriculum internationalisation (Ayadi & Ronco, 2023; Jowi, 2024).

The impact of internationalisation on higher education in Africa manifests in the areas of ensuring the quality and relevance of education through re-assessment of academic degrees and diplomas (Mkwananzi & Mukwambo, 2024; Ndaipa et al., 2023). It also helps in addressing issues of access and equity in higher education, particularly in the context of regional research and developmental needs (Amutuhaire, 2023; Dervin, 2024; Tight, 2022) and Sustainable Development Goals (SDGs, with higher education institutions playing a crucial role in its achievement, particularly in providing quality education and promoting sustainable development (Association of African Universities, 2021; Berchin et al., 2023; Lim, 2024; Toman et al., 2023).

Methodology

This study employed a qualitative case study research design, which entailed collecting and analysing data from reports, documents, and interviews. This design was deemed appropriate for exploring and understanding the opportunities and challenges of the internationalisation of higher education in Africa, while delving in depth into how it is being pursued in South Africa (Falaye, 2018). The population of this research comprised foreign academics and researchers at South African universities, from whom key informants were purposively sampled using a random purposive sampling technique. Therefore, faculty and postdoctoral researchers who were non-nationals of South Africa were sampled for the study, with a sample size of 7 participants. This sample met the minimum requirement of four to five cases for a qualitative case study design (Creswell, 2014; Ahmed, 2025).

Primary data were collected through in-depth interviews with key informants, an approach appropriate for understanding a broad range of people and settings, collecting detailed information, and studying past events of significance. The interviews were conducted face-to-face using Microsoft Teams, and each session lasted for about twenty to forty minutes. On the other hand, secondary data were generated from screenshots of documented evidence of postdoctoral research fellows' institutional access, based on their affiliations to universities in South Africa. In analysing the collected data, the recordings were automatically transcribed via Teams during the interview session to produce the interview scripts, which were thematically analysed according to the study's research questions.

Ethical Considerations: All requirements for studies involving human participants were adhered to in line with the ethical standards for research.

Results and Discussion

Research Question 1: What are the strategies for the internationalisation of higher education in South Africa?

Based on the coded data, the findings suggest that the internationalisation of higher education in South Africa is primarily driven by government-supported incentive structures and the recruitment of international academic talent. Two overarching themes emerged.

Theme 1: Policy and Funding Mechanisms as Drivers of Internationalisation. This theme captures how government policies and funding structures encourage universities to internationalise their academic communities and research output.

Sub-theme 1.1: Performance-Based Funding: Participants indicated that government funding is largely linked to institutional performance. Universities are therefore motivated to enhance their competitiveness by recruiting high-quality scholars and students from different countries who can contribute to institutional productivity.

"The majority of the fund they provide in South Africa is performance-based funding, where the funding you get sometimes depends on your level of performance."

Sub-theme 1.2: Publication Incentives: Publication productivity emerged as a key mechanism supporting internationalisation. Participants explained that institutions receive financial rewards for high research output, encouraging them to attract internationally experienced academics and researchers who can strengthen publication performance.

"When universities publish very well in South Africa, they actually get more funding. So this also encourages them to seek diverse nationalities that can enhance their publication profiles."

Sub-theme 1.3: Government-Incorporated Strategies

The findings further suggest that many internationalisation initiatives originate from national policy directives. Universities align their recruitment and research strategies with government expectations regarding performance and academic excellence.

"The strategy was actually incorporated from the government."

These findings show that internationalisation is not only institutionally driven but is embedded within a policy framework that uses funding incentives to encourage universities to engage globally through enhanced research productivity and international participation.

Theme 2: International Recruitment and Mobility of Academic Talent

This theme reflects the deliberate recruitment of international students, researchers, and academics as a key strategy for internationalisation.

Sub-theme 2.1: International PhD Recruitment

Recruiting doctoral students from across Africa and other regions emerged as one of the most common internationalisation practices. PhD students contribute to cultural diversity, knowledge exchange, and international research networks.

"They recruited a lot of Ph.Ds all over the world, most especially within African countries."

Sub-theme 2.2: Recruitment of International Postdoctoral Researchers

Participants highlighted the increasing reliance on international postdoctoral researchers, many of whom are foreign nationals. These researchers enhance research capacity and facilitate international collaboration.

"There are some universities that specialise in the recruitment of postdocs, who these days are 90% foreigners."

Sub-theme 2.3: Direct Recruitment of International Faculty

South African universities also recruit academic staff directly from other countries, including Asia, Europe, and North America. This strategy introduces diverse expertise, strengthens global networks, and enriches teaching and research environments.

"They also recruit faculties directly from outside the continent... Asia, China, United States, United Kingdom, etc."

The findings show that internationalisation is operationalised through the strategic recruitment of international human capital at multiple academic levels, including doctoral students, postdoctoral researchers, and faculty members. This approach promotes global knowledge exchange, enhances research quality, and strengthens international institutional linkages. The findings indicate that the internationalisation of higher education in South Africa is mainly pursued through government-driven funding and performance incentives, as well as the strategic recruitment of international doctoral students, postdoctoral researchers, and faculty members. These strategies enhance research productivity, diversify academic communities, foster global collaboration, and strengthen the international competitiveness of South African universities. The findings are further illustrated in the Thematic mapping in Figure 2.

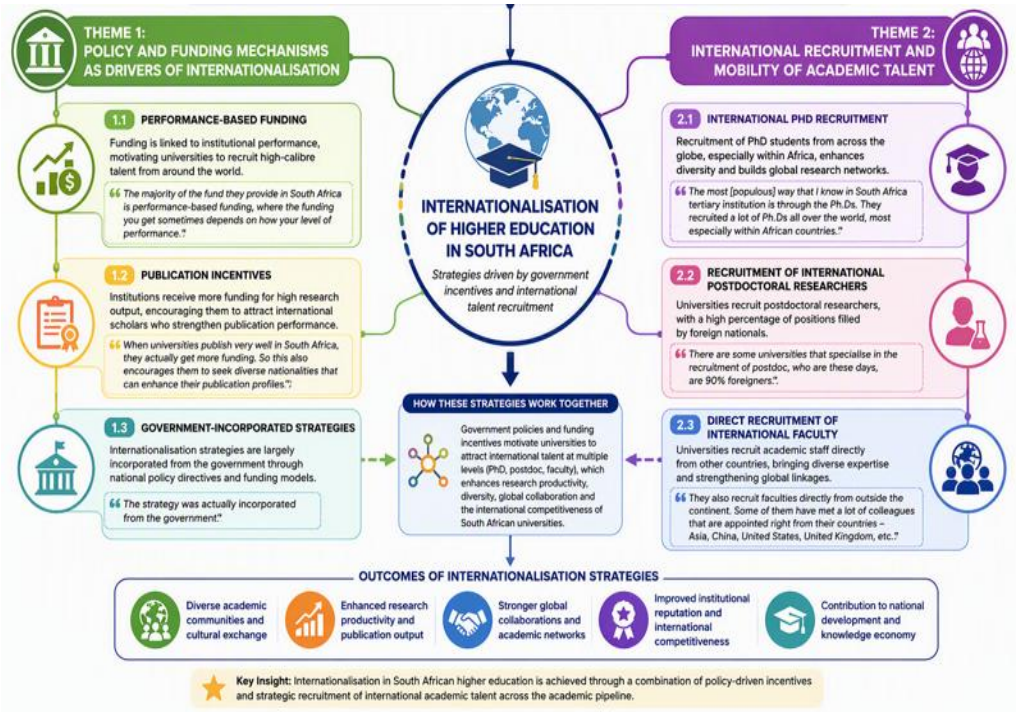


Figure 2: Thematic mapping of strategies for the internationalisation of higher education in South Africa

The thematic map reveals that the internationalisation of higher education in South Africa is driven by the interaction between policy and funding mechanisms, as well as by international recruitment of academic talent. The first theme, Policy and Funding Mechanisms as Drivers of Internationalisation, demonstrates how government policies create incentives for universities to engage globally. The literature indicates that internationalisation has become a strategic response to globalisation, with universities seeking to improve educational quality, research productivity, and global competitiveness through cross-border engagement (Shen et al., 2022; Suntharalingam, 2024). The performance-based funding and publication incentives identified by participants align with the broader objective of enhancing institutional visibility and academic excellence through international collaboration and knowledge exchange. The second theme, International Recruitment and Mobility of Academic Talent, reflects the practical implementation of internationalisation through the recruitment of international PhD students, postdoctoral researchers, and faculty members. According to the literature,

internationalisation involves the cross-border movement of students and academics, participation in global research networks, and institutional partnerships that facilitate knowledge transfer and capacity building (Shen et al., 2022; Jowi, 2024). Such recruitment enhances research output, cultural diversity, and academic quality while strengthening international networks. Furthermore, South Africa's policy frameworks and its status as a regional higher education hub support these recruitment efforts, enabling universities to attract talent from across Africa and beyond (Banda & Zungu, 2024). Together, these themes demonstrate that internationalisation is a policy-supported and talent-driven strategy for achieving global competitiveness and academic excellence.

Research Question 2: What are the opportunities of the internationalisation of higher education in South Africa?

The analysis of participants' responses reveals that the internationalisation of higher education in South Africa presents significant opportunities for expanding research collaboration, enhancing academic mobility through technology, strengthening regional partnerships, and improving policy environments that support global engagement. Two overarching themes emerged from the data.

Theme 1: Enhanced Global and Regional Research Collaboration

This theme reflects the opportunities created by international and regional partnerships that facilitate collaborative research, access to funding, and knowledge exchange.

Sub-theme 1.1: Funding Opportunities for International Research

Participants highlighted South Africa's ability to fund research projects that extend beyond national borders. Such funding promotes multinational research partnerships and increases the international visibility of South African scholarship.

"In South Africa, I have seen a project funded by NRF, but it's been implemented in other countries."

This finding aligns with the literature, which suggests that internationalisation facilitates research collaborations and knowledge sharing between institutions across different countries. Through global partnerships, universities gain access

to diverse expertise, research resources, and innovation opportunities (Jowi, 2024).

Sub-theme 1.2: Regional Cooperation and Academic Partnerships

Participants emphasised opportunities for collaboration between South African universities and institutions across Africa. Such collaborations strengthen regional integration, academic networking, and research capacity.

"Some countries provide funding that is even extended to other countries to do research."

The literature similarly notes a growing emphasis on intra-African academic collaboration through regional initiatives such as the Southern African Development Community (SADC) and the African Union, which promote academic mobility, research networks, and curriculum harmonisation (Kabeya et al., 2022; SADC, 2022).

This theme demonstrates that internationalisation provides South African universities with opportunities to establish regional and global research networks, attract collaborative funding, strengthen research capacity, and expand the impact of their scholarship beyond national boundaries.

Theme 2: Flexible Academic Mobility and Institutional Development: This theme captures opportunities created through technology-enhanced mobility, alternative academic appointments, and policy improvements that facilitate international engagement.

Sub-theme 2.1: Leveraging Technology for Virtual Internationalisation

Participants noted that technological advancements enable academics to contribute to South African higher education without being physically present in the country.

"For example, you can be employed as a postdoc. You can be employed as a research fellow, when you will not need to live in the country."

This finding supports literature arguing that technological developments and digital platforms have become important enablers of internationalisation, facilitating virtual collaboration, online research partnerships, and cross-border knowledge exchange (Mugimu, 2022; Oladele, 2024).

Sub-theme 2.2: Research Fellowships and Proxy Appointments

Participants described opportunities for international scholars to engage with South African institutions through flexible appointments such as research professorships and fellowships.

"You can be appointed as a Research Professor, which can be a proxy appointment."

These arrangements provide mechanisms for international academic engagement while reducing geographical barriers. Such opportunities contribute to knowledge transfer, institutional capacity building, and the development of international research communities (Jowi, 2024).

Sub-theme 2.3: Policy Reforms as Enablers of Internationalisation

Participants suggested that policy reform offers further opportunities to strengthen internationalisation by addressing barriers that currently limit international engagement.

"The majority of these challenges that I'm talking about are not the challenges that any policy has taken care of."

Literature similarly highlights the importance of policy frameworks in fostering academic mobility, research collaboration, and international partnerships. South Africa has already developed extensive policy frameworks to guide internationalisation, and further reforms could expand these opportunities (Banda & Zungu, 2024). The analysis reveals that the internationalisation of higher education in South Africa is achieved through a combination of policy-driven incentives and strategic international recruitment practices. Government funding mechanisms, particularly performance-based funding and publication rewards, create institutional motivations for international engagement. In response, universities actively recruit international PhD students, postdoctoral researchers, and academic staff to enhance research productivity, diversify institutional cultures, and strengthen global academic networks. These interconnected strategies position internationalisation as both a national policy objective and an institutional strategy for academic excellence. The findings are further illustrated in the Thematic mapping in Figure 3.

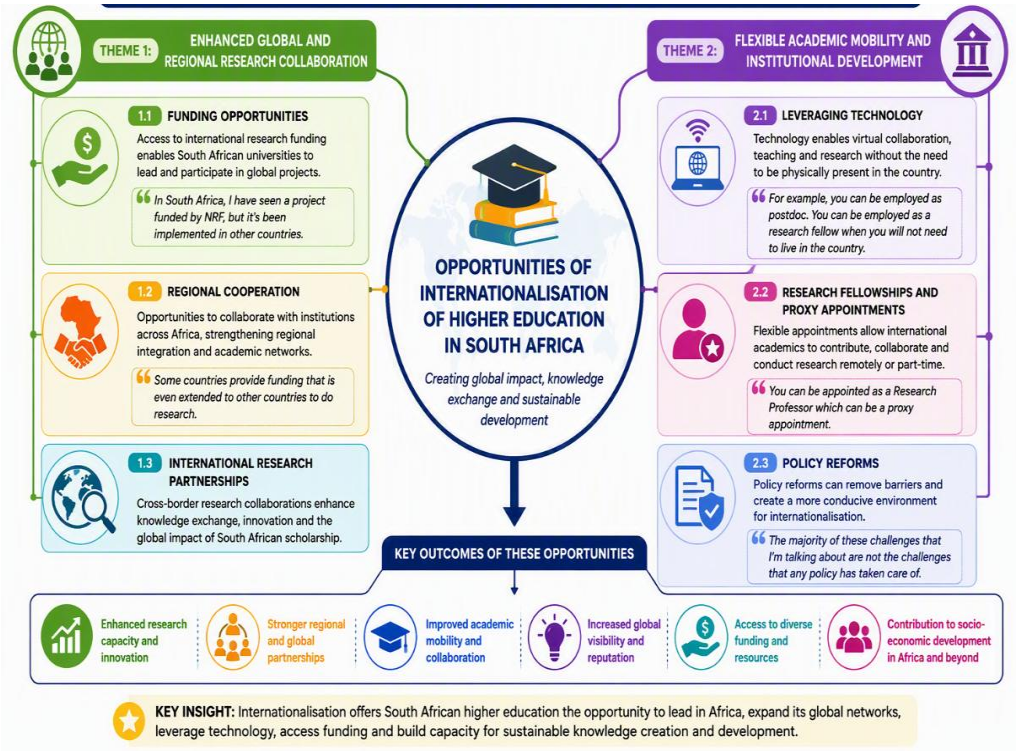


Figure 3: Thematic mapping of the opportunities for the internationalisation of higher education in South Africa

The thematic map illustrates that the opportunities associated with the internationalisation of higher education in South Africa are centred on enhanced research collaboration, flexible academic mobility, and institutional development. The first theme highlights how internationalisation creates opportunities for research funding, regional cooperation, and cross-border academic partnerships. The literature review emphasises that internationalisation enables universities to engage in collaborative research, student and faculty mobility, and institutional partnerships that enhance academic quality, global visibility, and competitiveness. These collaborations support knowledge exchange, curriculum development, and access to global research networks (Shen et al., 2022; Suntharalingam, 2024). Furthermore, partnerships with international institutions facilitate knowledge transfer, skill development, capacity building, and access to advanced research resources and technological innovations (Moshtari & Safarpour, 2024; Jowi, 2024). The second theme demonstrates how technology, research fellowship programmes, proxy appointments, and policy reforms expand opportunities for international

engagement. The literature notes that technological advancement is a major driver of internationalisation in higher education, enabling virtual collaboration and academic participation across borders (Mugimu, 2022; Oladele, 2024). In addition, regional initiatives such as the African Union's Continental Education Strategy and SADC frameworks promote academic mobility, research networking, and institutional cooperation across Africa (Kabeya et al., 2022; SADC, 2022). South Africa's extensive internationalisation policy frameworks further strengthen these opportunities and position the country as a leading higher education hub on the continent (Banda & Zungu, 2024). This theme suggests that internationalisation is increasingly facilitated by technological innovation and institutional flexibility, creating opportunities for broader participation in global knowledge networks while reducing traditional mobility constraints. Collectively, the thematic map demonstrates that internationalisation offers South African universities opportunities for research excellence, global partnerships, technology-enabled collaboration, capacity building, and sustainable institutional development.

Research Question 3: What are the challenges of the internationalisation of higher education in South Africa?

The analysis of participants' responses reveals that the internationalisation of higher education in South Africa is constrained by social exclusion and inequality, as well as institutional and structural barriers. Two overarching themes emerged from the data.

Theme 1: Social Exclusion and Barriers to International Academic Integration: This theme captures the social and institutional challenges faced by international academics and students in South African higher education institutions.

Sub-theme 1.1: Discrimination Against International Academics and Students: Participants reported that foreign academics and students often experience difficulties integrating into university environments and communities. These challenges affect their sense of belonging and ability to participate fully in academic life.

"Discrimination in the sense that the majority of foreign people find it difficult to acclimatise themselves, or some universities find it difficult to welcome them."

Literature similarly identifies cultural and social barriers as significant obstacles to internationalisation. Language differences, cultural exclusion, and limited inclusivity can hinder effective collaboration and mobility within higher education systems (Msomphora, 2025; Murove, 2018).

Sub-theme 1.2: Systematic Xenophobia and Institutional Barriers: Participants highlighted the existence of institutional practices and policies that disadvantage foreign academics despite their contributions and performance. These experiences suggest the presence of systemic inequities within some institutions.

“There are some policies. There are some artificial policies you find in some of these organisations. That actually worked against you…”

The literature review supports this concern by noting that unequal institutional structures and asymmetrical relationships often limit fair participation and decision-making opportunities for some groups within international collaborations (Molosi-France & Makoni, 2020). This theme suggests that while internationalisation promotes global engagement, discriminatory practices and xenophobic tendencies can undermine its objectives by restricting inclusion, diversity, and equitable participation.

Theme 2: Structural and Institutional Constraints to Internationalisation: This theme reflects challenges associated with resources, infrastructure, funding disparities, talent retention, and unequal international partnerships.

Sub-theme 2.1: Brain Drain and Loss of Academic Talent

Participants described the departure of highly skilled international academics from South Africa in search of better opportunities elsewhere.

“These challenges have sent so many foreign lecturers away from the country.”

This finding aligns with the literature identifying brain drain as a major challenge facing African higher education. The migration of talented academics weakens institutional research capacity and limits universities' ability to sustain quality education and innovation (Scholarworks & Osigbesan, 2021).

Sub-theme 2.2: Funding Inequality

Participants noted substantial differences in salaries, publication incentives, and institutional resources among universities. These disparities affect the capacity of some institutions to attract and retain international talent.

"There are variations in salaries. There are variations in how universities compensate publications."

The literature identifies inadequate funding and resource constraints as major barriers to internationalisation across African universities (Mugimu, 2022).

Sub-theme 2.3: Limited Infrastructure

Participants observed that while some South African universities possess world-class facilities, others lack adequate infrastructure to support internationalisation initiatives.

"There are some universities that are infrastructurally superb in South Africa. There are some that are deficient…"

This finding resonates with studies highlighting infrastructural limitations and technological disparities as obstacles to international engagement and research collaboration (Oladele, 2024; Mugimu, 2022).

Sub-theme 2.4: Inequality in International Collaboration

Participants further indicated that some international partnerships are unequal, with foreign institutions often benefiting more from collaborations than local universities.

"Some of those collaborations we sought for outside the continent…"

The literature similarly argues that collaborations between African universities and institutions in the Global North can be asymmetrical, resulting in unequal power relations and limited local control over research agendas (Molosi-France & Makoni, 2020). This theme demonstrates that internationalisation is constrained by resource disparities, infrastructure deficiencies, unequal partnerships, and the continued loss of skilled academics. These challenges limit universities' ability to maximise the benefits of global engagement. The findings reveal that the challenges of internationalising higher education in South Africa stem from both social exclusion and institutional constraints. Discrimination, xenophobia, and difficulties in integrating international academics undermine inclusivity and diversity within universities. At the same

time, brain drain, funding inequalities, inadequate infrastructure, and unequal international collaborations restrict the effectiveness and sustainability of internationalisation efforts. These findings support the existing literature, which identifies social barriers, resource constraints, unequal global partnerships, and talent migration as major impediments to higher education internationalisation in Africa (Molosi-France & Makoni, 2020; Mugimu, 2022; Scholarworks & Osigbesan, 2021; Msomphora, 2025). The findings are further illustrated in the Thematic mapping in Figure 4.

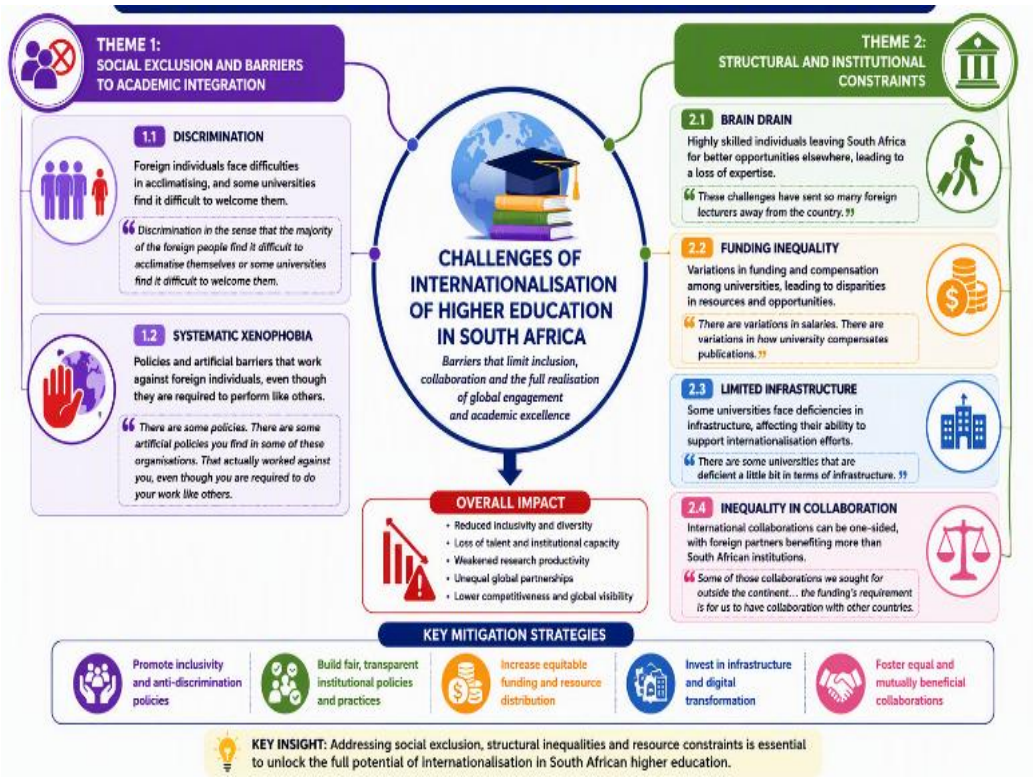


Figure 4: Thematic mapping of the Challenges of internationalisation of higher education in South Africa

The thematic map shows that the challenges of internationalisation in South African higher education operate at both social and structural levels. The first theme, Social Exclusion and Barriers to Academic Integration, encompasses discrimination and systematic xenophobia experienced by international academics and students. These challenges hinder successful integration into university communities and undermine the inclusiveness that internationalisation seeks to promote. The literature review similarly identifies

cultural and linguistic barriers as obstacles to effective internationalisation, noting that differences in language, culture, and institutional practices can limit regional and global cooperation (Msomphora, 2025; Murove, 2018). Furthermore, the literature emphasises that internationalisation should promote cultural exchange and global engagement, but exclusionary practices can restrict these benefits. The second theme, Structural and Institutional Constraints, comprises brain drain, funding inequality, limited infrastructure, and unequal collaborations. Participants reported that skilled academics often leave South Africa for better opportunities elsewhere, reflecting the broader challenge of brain drain identified in the literature. According to the literature review, brain drain weakens local research capacity and reduces universities' ability to provide quality education and conduct cutting-edge research (Scholarworks & Osigbesan, 2021). The literature also highlights inadequate funding, technological limitations, and asymmetrical partnerships with institutions from the Global North as major barriers to internationalisation (Mugimu, 2022; Oladele, 2024; Molosi-France & Makoni, 2020). Together, these challenges reduce institutional competitiveness, limit equitable participation in global knowledge production, and constrain the full realisation of internationalisation goals in South African higher education

Conclusion

Therefore, the study concludes that South Africa remains one of Africa's leading hubs for higher education internationalisation, with considerable potential to advance research collaboration, academic mobility, and institutional development. However, achieving the full benefits of internationalisation requires deliberate efforts to address social exclusion, strengthen institutional capacity, promote equitable partnerships, and create supportive policy environments for international scholars. Addressing these challenges will not only enhance South Africa's global competitiveness but also contribute to the broader development of higher education across the African continent.

Recommendations

The following recommendations are given to help South Africa maximise the opportunities offered by internationalisation while addressing the social and structural challenges that currently limit its effectiveness.

1. Strengthen inclusive institutional policies and support systems for international academics and students: South African universities should develop and implement comprehensive institutional policies that address discrimination, xenophobia, and barriers to integration faced by international academics and students. Such policies should include diversity and inclusion programmes, intercultural awareness training, mentorship schemes, and transparent recruitment, promotion, and remuneration practices. Creating a welcoming and supportive academic environment will enhance the retention of international talent, promote equitable participation, and strengthen multicultural learning experiences central to internationalisation. Addressing social exclusion will also help universities realise the full benefits of international collaboration, knowledge exchange, and global engagement.
2. Enhance equitable funding, infrastructure development, and collaborative partnerships: The government and higher education institutions should invest in reducing funding disparities and improving infrastructure across universities to support sustainable internationalisation. Increased investment in digital technologies, research facilities, and virtual collaboration platforms would expand access to international opportunities and strengthen institutional competitiveness. In addition, universities should pursue mutually beneficial international partnerships that promote shared decision-making, equitable resource distribution, and local research leadership. Such measures would reduce the effects of brain drain, strengthen research capacity, and ensure that international collaborations contribute meaningfully to national and continental development.

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CHAPTER TWENTY-NINE
Beyond the Credit Hour: Aligning Nigerian Graduate Education with Global Standards for Rigorous Research

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Abstract

The debate about Nigerian graduate education is often framed as a choice between credit-hour programmes and research-intensive training. This policy analysis argues that the credit hour is not a cause of weak research performance. It is an administrative measure of student workload that coexists with productive doctoral systems, including the United States. The policy problem is how coursework, supervision, funding, infrastructure, research integrity, milestones, and programme accountability are configured and implemented. Using a structured comparative review of policy documents, statistical reports, quality codes, and peer-reviewed studies published from 2021 to July 2026, the paper compares Nigeria with the United States, the United Kingdom, Germany, India, South Africa, Brazil, and African Centres of Excellence. Evidence shows that successful systems combine coursework with research immersion, accountable supervision, funded research environments, external examination, progress review, transferable-skills development, and programme-level evaluation. Nigerian evidence links low productivity more strongly to inadequate funding, limited research time, weak mentorship, deficient facilities, and fragmented research support than to credit accounting. The paper therefore proposes a dual architecture: retain credits for taught and transferable skills components, but make progression and graduation dependent on verified research competencies and milestone completion. Recommended reforms include a national graduate research quality framework, doctoral schools, supervisor accreditation and workload limits, student and project funding, shared research infrastructure, digital repositories, external examination, programme data dashboards, and phased performance-based review. Nigeria should move beyond treating credits as sufficient evidence of doctoral quality, rather than eliminating credit hours. Alignment with global standards requires research ecosystems, transparent governance, and enforceable outcomes.

Keywords: Graduate education, Credit hour, Research quality, Policy analysis.

Introduction

Graduate education is a central component of a national research and innovation system. It prepares advanced professionals, renews the academic workforce, supports public policy, and produces knowledge that can be translated into social and economic value. The global environment in which graduate education now operates has become more demanding. Research is increasingly collaborative, data-intensive, interdisciplinary, digitally mediated, and evaluated through explicit standards for integrity, reproducibility, societal relevance, and international visibility. Comparative education reporting also places doctoral education within wider systems of financing, participation, mobility, and labour-market outcomes (Organisation for Economic Co-operation and Development [OECD], 2024). UNESCO reported that global research expenditure increased by 19.2% between 2014 and 2018 and that the worldwide researcher population grew by 13.7%, although research capacity remained highly concentrated and 80% of countries still invested less than 1% of gross domestic product in research and development (UNESCO, 2021). These inequalities mean that graduate reform in Nigeria must address the institutional conditions under which research is undertaken, not only the formal structure of curricula.

The reviewed version of this article correctly identified important weaknesses in Nigerian postgraduate education, including inadequate funding, weak supervision, deficient laboratories and libraries, limited international exposure, fragmented governance, and the migration of experienced academics. Its central weakness, however, was the treatment of the credit-hour system as the primary cause of low research quality. That argument cannot be sustained comparatively. Credit hours are used in the United States, where universities awarded 57,862 research doctorates in 2023 and 79% of those doctorates were in science and engineering fields (National Center for Science and Engineering Statistics [NCSES], 2024). A credit-based system can therefore coexist with extensive research infrastructure, funded assistantships, rigorous candidacy procedures, original dissertations, external scholarly scrutiny, and strong publication cultures.

The relevant distinction is between an administrative unit and a quality-assurance architecture. A credit hour records an estimated volume of student work. It does not determine whether a doctoral candidate receives adequate supervision, has access to laboratories or data, completes defensible research milestones, follows ethical and open-science practices, or produces an original contribution. Current United States guidance defines a credit hour as an institutionally determined amount of student work approved through accreditation and expressly allows institutions to set higher standards or use other academic measures for non-federal purposes (U.S. Department of Education, 2025). Consequently, the policy question is not whether Nigeria should abolish credit hours. It is whether credits have been allowed to function as a substitute for evidence of research competence and whether the wider research ecosystem supports rigorous inquiry.

This article retains the original concern with global alignment but reframes the diagnosis. It argues that weak research performance is better explained by implementation failure and ecosystem constraints than by the existence of credits. It then uses recent comparative evidence to identify the institutional arrangements that make research-intensive graduate education possible. The resulting proposal is a dual architecture in which credits remain useful for taught components, while research progression and graduation are governed by competencies, milestones, independent assessment, and programme-level accountability.

Aim and Policy Questions

The aim of this policy analysis is to develop an empirically grounded framework for aligning Nigerian graduate education with current global standards for rigorous research without attributing research weakness to the credit-hour system itself. The analysis addresses four questions. First, what does comparative evidence show about the relationship between credit-based curricula and research-intensive doctoral education? Second, which institutional factors most plausibly constrain research quality and productivity in Nigeria? Third, which policy mechanisms used in other national systems are transferable to the Nigerian context? Fourth, how can Nigeria implement reform in a phased, financially realistic, and accountable manner?

Methodology

This article is a comparative policy analysis based on a structured review of recent secondary evidence. It is not presented as a systematic review or meta-analysis, and it does not report original survey or interview data. The method was designed to improve transparency, analytical discipline, and reproducibility while remaining appropriate for a policy paper.

The evidence searches covered publications issued from January 2021 to 28 July 2026. Targeted searches were conducted through official government and regulatory portals, international organisation repositories, university-sector bodies, and accessible peer-reviewed publisher platforms. Search terms combined the concepts doctoral education, graduate research quality, credit hour, doctoral supervision, research funding, programme evaluation, research integrity, Nigeria, United States, United Kingdom, Germany, India, South Africa, Brazil, and African Centres of Excellence. Sources were included when they met four criteria: publication within the stated period; direct relevance to doctoral governance, research training, supervision, funding, infrastructure, assessment, or quality assurance; institutional authority or transparent empirical methods; and online accessibility sufficient for verification. Opinion pieces without a disclosed evidence base, sources published before 2021, duplicate reports, and documents concerned only with undergraduate teaching were excluded.

The final evidence base comprised 16 sources: two peer-reviewed empirical studies focused on Nigerian research conditions and fourteen official, statistical, regulatory, or sector reports from national and international organisations. Countries were selected purposively to represent different governance models and levels of development. The United States provides a direct counterexample to the claim that credit hours prevent research intensity. The United Kingdom and Germany illustrate funded doctoral training and institutional quality frameworks. India demonstrates the combination of minimum coursework credits with research advisory committees and recurring progress review. South Africa provides an African system with national doctoral statistics and qualification standards. Brazil illustrates programme-level periodic evaluation. The World Bank-supported African Centres of Excellence provide a regional example of concentrated investment, accreditation, mobility, and research output.

Analysis proceeded in three stages. First, the Nigerian problem was disaggregated into inputs, processes, outputs, and governance. Inputs included finance, facilities, databases, staffing, and researcher time. Processes included supervision, methods training, ethics, milestone review, collaboration, and examination. Outputs included theses, publications, completion, research impact, and graduate destinations. Governance included regulation, programme approval, data reporting, incentives, and accountability. Second, comparable mechanisms were extracted from each international case. Third, those mechanisms were assessed for relevance, feasibility, equity implications, and compatibility with Nigeria's existing university and TETFund structures.

The method has limitations. National systems are internally diverse, reported statistics are not always based on identical definitions, and policy documents may describe formal expectations more clearly than actual practice. Causal claims are therefore made cautiously. International arrangements are treated as policy options rather than templates for direct transplantation. The analysis identifies plausible mechanisms supported by comparative evidence, but local pilots and subsequent evaluation are required before nationwide implementation.

Reframing the Policy Problem: Beyond a False Choice

A credible reform argument must distinguish three concepts that were previously conflated: credits, coursework dominance, and research quality. Credits quantify learning volume. Coursework dominance describes a programme design in which taught modules occupy disproportionate time or carry most progression consequences. Research quality concerns the originality, methodological robustness, integrity, transparency, and significance of scholarly work. These concepts can interact, but they are not interchangeable.

The United States makes the distinction clear. Federal guidance defines credits primarily for workload and student-aid purposes, while institutions and accreditors determine programme requirements and may impose higher or alternative academic standards (U.S. Department of Education, 2025). Research doctorates are separately defined through the expectation of an original intellectual contribution and a dissertation or equivalent research product. The scale of United States doctoral production, including 57,862 research doctorates in 2023, demonstrates that credit accounting does not

preclude research intensity (NCSES, 2024). The decisive variables are the resources, incentives, supervision, admissions standards, research culture, and assessment mechanisms surrounding the credits.

India offers a second counterexample. Its 2022 doctoral regulations require a minimum of 12 credits of coursework, including research methodology and research and publication ethics. At the same time, every scholar must have a Research Advisory Committee, present progress each semester, undergo plagiarism screening, and submit the thesis to external evaluation (University Grants Commission [UGC], 2022). The policy combines credits and research milestones rather than treating them as substitutes. South Africa similarly expresses qualifications through credit values, including doctoral qualifications, while national standards and institutional processes govern the level and quality of research. In 2023, South African public universities enrolled 25,475 doctoral students and produced 3,620 doctoral graduates, with a proxy doctoral graduation rate of 14.2% (Department of Higher Education and Training [DHET], 2025). These examples disprove a general structural claim against credits.

The problem in Nigeria is more precise. Credits may become harmful when institutions count course completion as sufficient evidence of graduate quality, when research is deferred until late in the programme, or when students receive credits for nominal seminars and methods courses without demonstrating competence. In such circumstances, the failure lies in programme design and implementation. Eliminating credits without correcting funding, supervision, infrastructure, research integrity, and accountability would change the unit of measurement while leaving the production system intact.

A stronger theoretical position is therefore ecosystem-based. Research quality is produced through the interaction of adequate inputs, well-designed processes, credible assessment, and accountable governance. Under this model, the expected effect of credits is conditional rather than causal. Credits can support quality when they are attached to substantive methods training, laboratory rotations, fieldwork, data stewardship, ethics, academic writing, and transferable skills. They can weaken the quality when they reward attendance or examination performance without authentic research tasks. The reform objective should be to limit the evidentiary role of credits and strengthen direct evidence of research capability.

Empirical Diagnosis of Nigerian Graduate Research

Recent Nigerian evidence supports an ecosystem diagnosis. Igiri et al. (2021) surveyed 2,350 academics and researchers across 66 universities, research institutes, and polytechnics in Nigeria's six geopolitical zones. Among the challenges reported by respondents, 42.98% identified a lack of research funding, 17.11% identified brain drain, and 8.85% identified a lack of motivation. More than half of the respondents reported publishing at least one article only once every two years. Although the study relied partly on self-reported data and covered researchers beyond postgraduate programmes, its national spread and sample size provide a more credible basis for policy discussion than unsupported generalisation.

A complementary study of social science research found that Nigeria has a substantial research community and produces a meaningful volume of peer-reviewed work, but that output remains below the country's potential because inputs, research time, institutional support, and coordination are weak (Egbetokun et al., 2022). This finding is analytically important. It shows that the problem is not an absence of scholarly capacity. It is the system's low efficiency and uneven quality that convert human talent into sustained, visible, and societally useful research.

Funding and Research Time

Research-intensive graduate education requires predictable funding at three levels: the candidate, the project, and the institution. Candidate funding supports living costs and protects time for research. Project funding pays for data collection, laboratory materials, fieldwork, software, dissemination, and ethical compliance. Institutional funding maintains laboratories, libraries, research offices, repositories, grant-management systems, and technical staff. Nigerian interventions have often focused on discrete grants or infrastructure projects, without consistently financing the full research pathway. A laboratory cannot produce high-quality theses if reagents are unavailable, equipment is not maintained, supervisors are overloaded, and candidates work full-time elsewhere to finance their studies.

The global context makes this deficiency consequential. UNESCO (2021) showed that research expenditure and researcher numbers were expanding worldwide, but resources remained concentrated in a small group of economies. Nigerian universities, therefore, compete in an environment where

well-funded systems can provide doctoral stipends, research assistants, laboratory technicians, data specialists, and publication support. The issue is not that every Nigerian programme must replicate the expenditure of a wealthy research university. It is that programmes should admit candidates only when the minimum resources for the proposed research can be demonstrated.

Supervision, Mentorship, and Workload

Supervision is the principal mechanism through which doctoral standards are interpreted in practice. Weakness arises when supervisory appointments are based only on rank, when workloads are uncapped, when feedback is delayed, or when a single supervisor controls progression without review. The Nigerian evidence on lack of mentorship and limited research support is consistent with this concern (Igiri et al., 2021). The problem is intensified by academic migration, uneven distribution of senior researchers across institutions and disciplines, and the absence of routine supervisor development.

Research-intensive systems increasingly treat supervision as an institutional responsibility rather than a private relationship. European doctoral policy now emphasises structured supervision, candidate support services, and career development within doctoral schools and programmes (Marti & Peneoasu, 2025). India requires a committee for each scholar rather than relying exclusively on one supervisor, while semester progress presentations create a documented opportunity for correction (UGC, 2022). Nigeria can adapt these mechanisms through co-supervision, supervisory panels, workload limits, and escalation procedures that protect both candidates and standards.

Infrastructure, Data, and Digital Research Capacity

The original article correctly identified outdated laboratories, weak library access, unstable connectivity, and limited access to journals and databases. These conditions affect different disciplines differently. Laboratory sciences require equipment, consumables, safety systems, and calibration. Social sciences require reliable data access, fieldwork funding, software, and secure data management. Humanities require archives, digitised collections, and research libraries. Across disciplines, candidates now require reference management, statistical or qualitative analysis tools, research data management, cybersecurity, and responsible use of artificial intelligence.

Infrastructure policy should therefore move from isolated procurement to lifecycle management. Procurement decisions should include utilisation plans,

technical staffing, maintenance contracts, power requirements, consumables, user access rules, and performance reporting. Shared regional facilities are preferable where sophisticated equipment would be underused by a single institution. Digital repositories and persistent researcher identifiers can also improve discoverability, reduce duplication, and preserve theses and datasets.

Research Integrity and Assessment

A thesis can satisfy formal length and formatting requirements while remaining methodologically weak. Quality assurance must therefore examine the research process, not only the final document. Minimum safeguards include approved protocols, ethics review where applicable, data-management plans, documented analysis, originality screening, transparent use of artificial intelligence, pre-submission seminars, and independent examination. Publication requirements should be used cautiously. Requiring an article can encourage scholarly communication, but a rigid rule may also drive candidates toward predatory journals or superficial salami publication. The stronger standard is a defensible original contribution assessed by competent independent experts, with publication support and journal-quality guidance.

Current global frameworks increasingly combine institutional responsibility with external scrutiny. The 2024 UK Quality Code frames academic standards and quality enhancement as responsibilities that providers must evidence through coherent processes (Quality Assurance Agency for Higher Education [QAA], 2024). Brazil's CAPES system evaluates graduate programmes periodically and publishes programme ratings, connecting programme performance with national oversight rather than leaving quality to individual theses alone (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior [CAPES], 2026). Nigeria requires a comparable shift from episodic accreditation toward continuing programme evidence.

Governance, Incentives, and Data Deficits

Fragmented responsibility weakens implementation. The National Universities Commission regulates programme standards, TETFund finances major interventions, universities control admissions and supervision, professional bodies influence some disciplines, and external examiners assess theses. These roles are individually legitimate but are not always connected through a shared graduate research performance framework. Consequently, the system lacks a consistent national dataset on doctoral admissions, funding status, supervisory

loads, time to degree, attrition, examination outcomes, publications, research integrity cases, employment destinations, and international collaboration.

Incentives also matter. When promotion systems reward publication counts without sufficient attention to quality, academics may prioritise volume. When departments receive reputational benefits from enrolment and completion but bear few consequences for attrition or poor examination, throughput can dominate. When candidates pay fees for extended periods, institutions may have conflicting incentives regarding timely completion. Policy reform must align incentives with credible outputs, ethical conduct, timely completion, and demonstrable societal or scholarly contribution.

Comparative Policy Evidence and Transferable Lessons

United States: Credit Accounting Plus Research Intensity

The United States is the most important comparator because it directly contradicts the claim that credit hours inherently undermine doctoral research. Credits are widely used, but doctoral quality is built through selective admission, funded research groups, laboratory or field immersion, qualifying examinations, candidacy, dissertation committees, research assistantships, and an original dissertation. NCSES data show both the scale and disciplinary breadth of the system: 57,862 research doctorates were awarded in 2023, and 79% were in science and engineering (NCSES, 2024). The lesson for Nigeria is not to copy a decentralised American model wholesale. It is to recognise that workload metrics and research standards perform different functions. Nigerian regulation should state explicitly that credit completion is necessary only for specified taught components and is never sufficient for the award of a research degree.

United Kingdom and Europe: Quality Codes, Doctoral Structures, and Career Development

The United Kingdom combines institutional autonomy with sector-wide reference points. The 2024 UK Quality Code articulates principles for securing academic standards and enhancing quality, while UK Research and Innovation reorganised doctoral funding around focal and landscape awards and announced more than £500 million for doctoral studentships in 2024 (QAA, 2024; UK Research and Innovation [UKRI], 2024). The funding model is linked to expectations for recruitment, training, research outcomes, and wider professional development.

Across Europe, doctoral schools have become important organisational structures for supervision, training, candidate services, mobility, and career development. European sector reviews emphasise structured doctoral provision, supervisory practice, candidate support services, and preparation for diverse careers rather than treating the doctorate as an isolated apprenticeship (European University Association, 2022; Marti & Peneoasu, 2025). Nigeria can adopt the organisational logic of doctoral schools without creating expensive new bureaucracies. A doctoral school can be a coordinated institutional platform that provides common methods courses, ethics training, data support, supervisor development, milestone monitoring, and international partnerships across faculties.

Germany: Concentrated Funding and Structured Research Training

Germany's Research Training Groups demonstrate how competitive funding can build cohorts around defined research themes. In 2024, the German Research Foundation approved 17 new groups with approximately EUR123 million for an initial five-year period and reported funding 214 groups in total, including 26 international groups (Deutsche Forschungsgemeinschaft [DFG], 2024). These groups combine high-level disciplinary research with structured training and, in some cases, international partners. The transferable lesson is the value of concentration. Rather than dispersing limited funds across every department, Nigeria should fund competitive thematic doctoral clusters with clear staffing, infrastructure, candidate support, and output commitments.

India: Credits Combined with Advisory Committees and Milestones

India's 2022 regulations show that coursework credits can be retained while research governance is strengthened. The framework requires at least 12 coursework credits, including research methodology and research and publication ethics. It also creates a Research Advisory Committee for every doctoral scholar, requires semester progress presentations, mandates integrity screening, and provides for external thesis evaluation (UGC, 2022). This combination is directly relevant to Nigeria because both systems include large, diverse higher education sectors and uneven institutional capacity. The practical lesson is to attach credits to demonstrable competencies while making progression dependent on committee-reviewed research milestones.

South Africa: National Statistics and Qualification-Level Accountability

South Africa provides a regional comparator with a differentiated university system and formal qualification standards. Public universities enrolled 25,475 doctoral students and awarded 3,620 doctorates in 2023. The reported proxy graduation rate for doctoral qualifications was 14.2% (DHET, 2025). These data do not prove quality by themselves, but their regular publication makes system performance visible and supports planning. Nigeria's immediate lesson is the need for a national graduate education data system that reports enrolment, completion, field, gender, institution, funding, and time-to-degree using stable definitions.

Brazil: Periodic Programme Evaluation

Brazil's CAPES model evaluates stricto sensu graduate programmes through disciplinary committees and periodic national review. Results of the 2021-2024 evaluation were published in 2026, with programme scores, reconsideration procedures, and public reporting mechanisms (CAPES, 2026). The central policy insight is that quality should be assessed at the programme level, not inferred solely from institutional accreditation or individual thesis examination. A programme that repeatedly shows excessive attrition, weak outputs, inadequate supervision, or integrity failures should enter improvement status, face reduced admissions, or lose approval.

African Centres of Excellence: Regional Scale and Accountable Investment

The African Centres of Excellence programme demonstrates that research capacity can be built within African universities when investment, specialisation, regional collaboration, accreditation, and measurable outputs are connected. By 2025, the programme had established more than 80 centres in over 50 universities across 20 countries, enrolled more than 90,000 students, including 7,650 doctoral candidates, supported over 130 internationally accredited programmes, and generated more than 10,350 internationally peer-reviewed publications (World Bank, 2025). These figures are programme-reported and should not be interpreted as an independent causal evaluation. They nevertheless show the scale that can be achieved through concentrated, monitored, cross-border investment. Nigeria should expand participation in such networks and apply similar accountability to nationally funded centres.

A Policy Framework for Nigeria

The evidence supports a reform strategy that moves beyond the credit hour as the dominant proof of academic progress while retaining it where it remains useful. The proposed model has two connected layers. The taught layer uses credits for advanced theory, research methods, ethics, data analysis, academic writing, pedagogy, innovation, and professional skills. The research layer uses verified milestones and competencies. No candidate should graduate because a prescribed number of credits has been accumulated. Graduation should require an independently examined original contribution and a documented record of responsible research practice.

National Graduate Research Quality Framework

The National Universities Commission, in collaboration with universities, TETFund, professional bodies, research institutes, employers, and doctoral candidates, should establish a National Graduate Research Quality Framework. The framework should specify minimum outcomes rather than impose a uniform curriculum. Required outcomes should include advanced disciplinary knowledge, methodological competence, ethical judgement, data stewardship, capacity to communicate research, ability to situate findings within international literature, and evidence of an original contribution.

The framework should distinguish master's degrees by coursework, professional master's degrees, research master's degrees, professional doctorates, and research doctorates. Different awards require different balances of taught learning and research, but each must have explicit outcome statements. Universities should retain autonomy to exceed the minimum and to design discipline-appropriate routes.

Milestone-Based Progression

Doctoral progression should be organised around a national minimum sequence with room for disciplinary adaptation. The sequence should include: an approved research concept and resource plan at admission; completion of required methods and integrity training; confirmation of candidature after proposal defence; ethics approval where applicable; annual or semester progress review; data or evidence audit; pre-submission seminar; originality and integrity checks; independent external examination; and oral defence where required. Each milestone should have written criteria, a decision record, corrective actions, and an appeal route.

Credits may be attached to methods courses, laboratory rotations, fieldwork preparation, or transferable skills, but milestone decisions should be based on performance. For example, passing a statistical methods course should not substitute for demonstrating that the candidate can select, justify, execute, and interpret an analysis appropriate to the thesis.

Doctoral Schools and Research Clusters

Universities with sufficient scale should establish doctoral schools or equivalent coordinated structures. Smaller institutions should form regional or thematic consortia. These structures should pool methods teaching, integrity training, data services, writing support, grant development, and career preparation. They should also maintain candidate records and intervene when supervision fails.

Competitive national funding should support thematic research clusters in areas linked to Nigeria's scientific, social, cultural, industrial, and policy priorities. Selection should be based on demonstrated supervisory capacity, infrastructure, partnerships, data access, and a credible candidate-support plan. Funding should be multi-year and subject to mid-term review. Concentration is necessary because distributing small amounts to every programme may create formal inclusion without research viability.

Supervisor Accreditation, Teams, and Workload Limits

Supervision should be recognised as specialised academic work. Eligibility should require recent research activity, integrity training, supervision development, and knowledge of institutional procedures. New supervisors should work within teams before serving as principal supervisors. Every doctoral candidate should have at least two supervisors or a supervisor plus an advisory panel, with one member independent of the immediate unit where feasible.

Universities should publish maximum supervisory loads by discipline and degree level. Workload allocation must account for the intensity of laboratory, field, clinical, creative, and data-intensive research. Annual candidate feedback should be reviewed at programme level, not used as the sole measure of supervisor performance. Persistent delay, non-response, conflict of interest, or ethical breach should trigger remediation or suspension of supervisory eligibility.

Funding Reform

TETFund and other public funders should move toward integrated graduate research packages. TETFund's annual reporting provides an institutional base from which more transparent graduate-research funding, utilisation, and outcome reporting can be developed (Tertiary Education Trust Fund [TETFund], 2023). A package may combine a candidate stipend or fee support, project costs, supervisor or technical support, infrastructure access, research dissemination, and institutional indirect costs. Competitive selection should be transparent and should protect equitable access across regions, institutions, disciplines, gender, and disability status.

Funding should be released against verified milestones rather than calendar time alone. Institutions should report expenditure, outputs, delays, and equipment utilisation. Programmes should not admit candidates into resource-intensive projects without a documented funding and facility plan. Private-sector and philanthropic participation should be encouraged, but academic independence, publication rights, conflict-of-interest disclosure, and data governance must be protected.

Shared Infrastructure and Digital Transformation

Nigeria should develop a network of shared research facilities rather than replicate expensive equipment in every university. Each facility should publish access rules, pricing or subsidy arrangements, maintenance status, technical expertise, and utilisation data. National procurement should prioritise interoperability, service contracts, spare parts, power resilience, and technician training.

Every approved doctoral programme should provide access to current scholarly literature, institutional repositories, plagiarism and similarity tools, secure data storage, statistical or qualitative software, and research data management support. Theses should be deposited in interoperable repositories with persistent identifiers, subject to ethical or security restrictions. Open science should be promoted through appropriate data and protocol sharing, while recognising confidentiality, indigenous knowledge rights, commercial sensitivity, and national security.

Internationalisation and Industry Collaboration

Internationalisation should be designed around research value rather than symbolic agreements. Priority mechanisms include joint supervision, cotutelle degrees, visiting scholars, shared seminars, regional methods schools, access to specialised facilities, collaborative grants, and reciprocal mobility. Participation in African research networks should receive equal policy attention with partnerships outside the continent.

Industry and public-sector collaboration can improve relevance, provide data and facilities, and broaden graduate careers. However, industry-linked doctorates require clear agreements on intellectual property, publication, confidentiality, ethics, and candidate assessment. Research questions should remain academically defensible and should not be reduced to consultancy deliverables.

Programme-Level Evaluation and Public Data

Nigeria should introduce a periodic national review of graduate programmes, drawing selectively on Brazil's programme-level evaluation and South Africa's statistical reporting. Evaluation should combine quantitative indicators with peer judgement. Core indicators should include admissions selectivity, funding coverage, supervisory loads, candidate-to-completion progression, time to degree, attrition, examination outcomes, publication quality, research integrity, graduate destinations, international collaboration, societal engagement, and candidate experience.

Indicators must be interpreted by discipline and should not reward raw publication counts. Humanities monographs, creative outputs, policy datasets, patents, clinical guidelines, and community-based outcomes require appropriate recognition. Programme ratings should have consequences. High-performing programmes may receive development grants and expanded admissions. Programmes with correctable deficiencies should enter monitored improvement. Programmes that cannot meet minimum research conditions should suspend admissions until capacity is restored.

Phased Implementation Roadmap

Phase 1: Foundation, 0-2 Years

The first phase should establish definitions, data, and minimum safeguards. The NUC should convene a national working group and issue the Graduate

Research Quality Framework. Universities should map all graduate programmes, candidates, supervisors, facilities, completion patterns, and integrity procedures. New doctoral admissions should require a resource statement and supervisory capacity check. Institutions should introduce advisory panels, standard progress reports, supervisor training, candidate handbooks, and accessible grievance mechanisms. A national graduate education dashboard should begin with a limited set of auditable indicators.

Phase 2: Capacity Building and Pilots, 3-5 Years

The second phase should fund competitive doctoral schools, thematic clusters, and shared facilities. TETFund should pilot integrated candidate and project awards in selected disciplines and institutions. Programme-level review should begin with a developmental cycle that identifies gaps without immediate punitive consequences. Joint supervision, regional consortia, and international partnerships should be expanded. Digital thesis repositories and research data support should become mandatory for accredited programmes.

Phase 3: Performance-Based Consolidation, 6-10 Years

The third phase should connect programme approval, admissions, and funding to verified performance. Periodic national evaluation should be fully operational, with published results and decisions on improvements. Funding formulas should reward completion quality, integrity, collaboration, and equitable candidate development rather than enrolment volume. Programmes unable to sustain minimum standards should merge, enter consortia, or suspend admissions. Successful clusters should receive longer-term support and stronger pathways to commercialisation, policy translation, or public engagement.

Implementation Risks and Safeguards

Reform can fail if new requirements become additional paperwork without resources. Milestones should therefore replace redundant approvals rather than accumulate on top of them. Digital reporting should reuse institutional data and be audited selectively. Smaller and newer universities should receive consortium options and capacity grants rather than being permanently excluded.

Performance funding can also create gaming. Publication counts may encourage low-quality outlets, completion targets may lower examination

standards, and internationalisation metrics may reward superficial partnerships. Balanced peer review, field-normalised indicators, integrity audits, candidate feedback, and transparent qualitative evidence are necessary safeguards. No single metric should determine programme status.

Equity must be built into implementation. Full-time, well-funded doctoral models may exclude candidates who work, care for dependents, or live far from campus. Programmes should offer transparent part-time routes with realistic milestones and equivalent standards. Funding competitions should monitor participation and success by gender, disability, region, socioeconomic background, and institution type. International mobility should not be the only route to quality because many candidates cannot travel.

Finally, reform requires political and institutional stability. Multi-year funding commitments, protected academic decision-making, open procurement, and public reporting are necessary to prevent policy discontinuity. A national framework should set the floor, but disciplinary communities and universities must retain sufficient autonomy to innovate above it.

Conclusion

Nigeria's graduate education challenge cannot be explained by the credit-hour system alone. Comparative evidence shows that credit-based structures coexist with highly research-intensive doctoral programmes. The United States uses credits while producing tens of thousands of research doctorates. India combines minimum coursework credits with advisory committees, recurring progress review, integrity safeguards, and external examination. South Africa uses credit-based qualification structures and publishes national doctoral data. The United Kingdom, Germany, Brazil, and African Centres of Excellence demonstrate the importance of funded training, doctoral structures, periodic programme review, and concentrated research investment.

The central Nigerian weakness is therefore not the existence of credits but the tendency to treat course completion as sufficient proof of graduate quality within an under-resourced and inconsistently governed research ecosystem. The original concerns about funding, supervision, infrastructure, global exposure, policy coherence, and academic migration remain valid, but they must be supported by evidence and connected through a defensible causal model.

Nigeria should retain credit for taught and professional development components while making research progression and graduation dependent on competencies, milestones, integrity, and independent assessment. A national graduate research quality framework, doctoral schools, trained supervisory teams, integrated funding, shared facilities, digital research systems, international and industry collaboration, and programme-level evaluation provide a practical reform architecture. The policy objective is not to move away from credits as an administrative tool. It is to move beyond credits as a proxy for rigorous research. Global alignment will depend on whether Nigeria builds and sustains the institutional conditions in which original, ethical, well-supported, and internationally credible research can be produced.

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CHAPTER THIRTY

Economic Assessment of Cinnamon-Enriched Diets in African Catfish Hybrid (Clarias gariepinus ♀ × Heterobranchus bidorsalis ♂) Cultivation

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Abstract

An assessment of the economic feasibility of including cinnamon in the diet of hybrid African catfish (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) was conducted throughout a 56-day feeding trial. Two hundred and ten fingerlings of hybrid African catfish were acclimatised for one week, weighed, and assigned to five feeding regimens containing 0, 0.5, 1.0, 1.5, and 2.0.% cinnamon. The diets were isonitrogenous at 38% and isolipidic at 12%. Each treatment was replicated three times, with 14 fish per replication. Fish were fed 5% of their body weight in two equal portions daily. An economic analysis was conducted utilising cost incidence, profit index, profitability ratio, and cost-return analysis as analytical instruments. The study's results demonstrated the viability of utilising cinnamon, as evidenced by favourable gross margins and net returns. CTR exhibited the highest levels of BCR and ROR, whilst DT5 showed the lowest. No significant differences ($p>0.05$) were seen in the BCR of fish fed the CTR and cinnamon-treated diets, except DT5. As the concentration of cinnamon increased, the BCR and ROR decreased. This study concluded that producing African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) with diets using cinnamon powder is economically viable. Reduced levels of cinnamon powder (0.5g/100g) in dietary formulations appear to yield economic returns similar to those of the control group.

Keywords: Cost incidence; Profit index; Profitability ratio; Cost-return analysis.

Introduction

Aquaculture can serve as an economical and high-quality protein source for human consumption and enhanced health (Ansari et al., 2021). The aquaculture sector has expanded globally because of advancements in production technology and cultivation techniques (Amenyogbe et al., 2018; Boyd et al., 2020; Naylor et al., 2021). The increased use of intensive fish production techniques by farmers to meet market demands and enhance profitability induces stress, alongside an elevated risk of disease and loss (Hoseinifar et al., 2020). The adverse environmental impacts of chemical use prompted the enactment of laws restricting their use as curative or preventive measures in aquaculture (Okocha et al., 2018). Consequently, dietary modifications, including the use of medicinal herbs in fish diets to promote growth and boost health, have been suggested as a feasible solution (Alagawany et al., 2021). Medicinal herbs have become increasingly favoured for the prevention and treatment of fish illnesses due to their environmental safety, cost-effectiveness, and minimal detrimental effects compared to chemical growth promoters and health enhancers (Doan et al., 2020). Plant-derived compounds rich in bioactive secondary metabolites have been shown to enhance fish immunity (Gabriel, 2019). Phytochemicals, which are active substances derived from plants, possess immunostimulant, biocidal, anti-stress, and growth-promoting effects. Tannins, alkaloids, pigments, essential oils, steroids, terpenoids, flavonoids, and phenolics are the predominant phytochemicals (Elumalai et al., 2020). Medicinal plants possess the capacity to treat and prevent fish illnesses owing to their rich content of secondary metabolites, which exhibit activity against various bacteria and fungi (Lieke et al., 2020). Recent applications of medicinal plant products (powders, essential oils, extracts, and isolated compounds) have been used to mitigate the adverse effects of stressors on fish, including toxicants and unfavourable environmental conditions (Tadese et al., 2021). Numerous studies have demonstrated that intact herbal materials and extracts enhance fish performance and welfare (Alagawany et al., 2021; Souza et al., 2019; Zhu, 2020).

Intact plant components, including turmeric (Curcuma longa), coffee bean (Coffea arabica), green tea (Camellia sinensis), Myrcia sylvatica, rhubarb (Rheum officinale), Roselle (Hibiscus sabdariffa), and ginger (Zingiber officinale), have been shown to enhance growth performance and mitigate stress in fish, as evidenced by various research studies (Abdel-Tawwab et al.,

2018; El Mesallamy et al., 2016; Fagbenro et al., 2004; Kuo et al., 2020; Pérez-Escalante et al., 2012; Sodamola et al., 2016).

Feed constitutes a substantial expense in the fish production cycle and is a critical determinant of the profitability and sustainability of aquaculture, representing 60 to 70 percent of the variable costs associated with fish production (Jimoh et al., 2020; Jimoh et al., 2019). Despite extensive research on the growth and health benefits of incorporating medicinal plants into fish feed, the economic ramifications of utilising medicinal plants, such as cinnamon powder, in fish feed, especially in terms of fish production economics, are yet to be investigated. This study, therefore, investigated the production economics of cinnamon supplementation in the diet of hybrid African catfish (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂).

Methods

Sources, Ingredient Processing, and Experimental Diets

Cinnamon powder, fish meal, soybean meal, and other beneficial feedstuffs were sourced from commercial suppliers in Ilorin, Nigeria, milled and screened separately to achieve a fine particle size, and duplicate samples were analysed for their proximate composition (AOAC, 2005). Cinnamon was included at concentrations of 0, 0.5, 1.0, 1.5, and 2.0g/100g in the experimental diets, designated as CTR, DT2, DT3, DT4, and DT5 (Table 1). The designed diets were isolipidic and isonitrogenous, including 12% crude lipid and 38% crude protein, respectively. To facilitate binding, the feedstuffs were pulverised and hot water was incorporated. The material was further processed through a pelleting and mixing apparatus, followed by a mincer to produce 2mm pellets, which were then immediately sundried at 30-32°C. The diets were preserved in a cold location during a three-day drying period. The nutritional composition (fatty and amino acids) of the experimental meals (Table 2) was assessed using a tool (Excel) developed by the Network of Aquaculture Centres in Asia-Pacific (NACA) in 2008.

Table 1: Gross Composition (G/100g) of Cinnamon-Supplemented Diet Fed to African Catfish Hybrid (*Clarias Gariepinus* ♀ X *Heterobranchus Bidorsalis* ♂)

Ingredients	CTR	DT2	DT3	DT4	DT5
Fishmeal@72%cp	27.80	27.80	27.80	27.80	27.80
SBM@44% cp	44.50	44.50	44.50	44.50	44.50
Yellow Maize@10%cp	4.00	4.00	4.00	4.00	4.00
Cinnamon	0.00	0.50	1.00	1.50	2.00
Fish Premix	5.00	5.00	5.00	5.00	5.00
Fish oil	2.50	2.50	2.50	2.50	2.50
Soy Oil	2.50	2.50	2.50	2.50	2.50
Starch	13.70	13.20	12.70	12.20	11.70
Total	100	100	100	100	100

Each kg of the Agri-mix fish premix contains Vitamin A 1500000 i.u, Vitamin B1 800mg; Vitamin B2 1,600mg, Vitamin B6 1,500mg, Vitamin B12 4mg, Vitamin D3 3,000,000 i.u, Vitamin E 200000mg, Vitamin C 240g, Folic Acid 300mg, Niacin 5970 mg, Biotin 40 mg, Pantothenic Acid 4000mg, Copper 800mg, Iodine 191mg, Iron 1200mg, Manganese 20,323mg, Selenium 60mg, Zinc 15996 mg, Choline 87000mg. Manufactured by Agri-Dom 20/22 Kolawole Shonibare Street, Ajao Estate, Lagos. www.agri-domintegrated.com.ng

Experimental Set-up and Feeding

The experiment was performed at the wet laboratory of the Department of Aquaculture and Fisheries at the University of Ilorin, Nigeria. The hybrid catfish fingerlings were procured from a reputed hatchery in Ilorin and transported to the project location in an aerated bag. Two hundred and ten hybrid catfish fingerlings were acclimatised to commercial catfish pelleted diet

for seven days prior to the feeding study. Each treatment consisted of five trials with three replicates, and each tank contained fourteen fingerlings. The tanks were randomly allocated to the experimental diet and were fed 5% of their body weight in two equal portions over 56 days, specifically during 9:00–10:00 am and 5:00–6:00 pm.

Analysis of Production Economics

The analysis of Production Economics was conducted using the indices (equations 1–11) as documented in Jimoh et al. (2019) and Jimoh et al. (2020).

$$Incidence\ of\ Cost = \frac{Cost\ of\ Feed}{Weight\ of\ Fish} \quad \text{..... (1)}$$

$$Profit\ Index = \frac{Value\ of\ Fish}{Cost\ of\ Feed} \quad \text{..... (2)}$$

$$Profit/kg\ \ = Value\ of\ 1kg\ fish - Incidence\ of\ cost \quad \text{.....(3)}$$

$$Total\ Cost\ (TC) = TVC + TFC \quad \text{.....…(4)}$$

Where TVC = Total Variable Cost (Cost of fingerlings + Cost of Feeding)

TFC = Total Fixed Cost (Cost of Aquaria Tanks)

Total Revenue(TR)=Price of Fish×Biomass Output (kg).....…..……(5)

Gross Margin (GM) =TR-TVC..... (6)

Net Return (NR) =GM-TFC ..... (7)

Expense Structure Ratio(ESR)=(Fixed Cost)/(Total Cost)..... (8)

Benefit-Cost Ratio (BCR)=(Total Revenue)/(Total Cost).....(9)

Gross Ratio (GR)=(Total Cost)/(Total Revenue).....(10)

Rate of Return (ROR)=(Net Return)/(Total Cost).....(11)

The straight-line method was used to assess the depreciation cost of aquaria tanks with the following properties;

Cost of Plastic Tanks (₦)	55,000
No of Years (Life span in years)	5
Savage Value (10%) (₦)	5,500

$$Depreciation = \frac{Cost\ Price - Salvage\ value}{Life\ Span}$$

$$Depreciation = \frac{55{,}500 - 5{,}500}{5} = ₦\ 9{,}900$$

$$Depreciative\ Cost\ of\ 2\ months\ plastic\ use = \frac{9{,}900}{12} \times 2 = ₦\ 1{,}650$$

$Depreciative\ Cost\ (TFC) = ₦\ 1{,}650$

Cost of Fingerlings =

(14*₦28) ₦ 392

Table 2. Nutrient Composition (G/100g As Fed Basis) of the Experimental Diets

Proximate Composition (%)	CTR	DT2	DT3	DT4	DT5
Moisture	8.14	8.12	8.10	8.08	8.06
Crude Protein	37.82	38.00	38.19	38.38	38.58
Crude Lipid	12.31	12.40	12.50	12.59	12.69
Ash	7.39	7.42	7.44	7.47	7.50
Crude Fibre	5.91	5.92	5.93	5.94	5.95
NFE	28.44	28.14	27.84	27.54	27.24
Amino Acid Composition (%)					
Arginine %	3.00	3.01	3.03	3.04	3.06
Histidine	0.94	0.94	0.94	0.95	0.95
Isoleucine	1.84	1.85	1.85	1.86	1.87
Leucine	3.00	3.01	3.03	3.04	3.06
Lysine	2.82	2.83	2.85	2.86	2.88
Methionine	0.86	0.87	0.87	0.88	0.88
M+C	1.38	1.39	1.39	1.40	1.41
Phenylalanine	1.76	1.77	1.78	1.79	1.80

P+T	3.05	3.07	3.08	3.10	3.11
Threonine	1.78	1.79	1.80	1.81	1.82
Tryptophan	0.47	0.47	0.47	0.47	0.48
Valine	2.00	2.01	2.02	2.03	2.04
Fatty Acid Composition (%)					
LOA (18:2n-6)	4.89	4.92	4.94	4.97	4.99
LNA (18:3n-3)	0.69	0.70	0.70	0.71	0.71
ARA (20:4n-6)	0.07	0.07	0.07	0.07	0.07
EPA (20:5n-3)	0.35	0.35	0.36	0.36	0.36
DHA (22:6n-3)	0.82	0.82	0.83	0.83	0.84
Total n-3	1.87	1.88	1.89	1.90	1.91
Total n-6	4.96	4.99	5.01	5.04	5.07
n3:n6	0.38	0.38	0.38	0.38	0.38
Total phospholipid%	2.69	2.70	2.72	2.73	2.74

LOA: Linoleic Acid; LNA: Linolenic Acid; ARA: Arachidonic Acid; EPA: Eicosapentanoic Acid; DHA Docosahexanoic Acid

Statistical Analysis

The data were presented as the mean and standard error of the mean (SEM). A one-way Analysis of Variance (ANOVA) was conducted in IBM SPSS Statistics for Windows, version 20.0, to evaluate the importance of each profitability evaluation parameter. Where substantial variance ($p<0.05$) was observed, Tukey's B was employed to distinguish significant differences among individual treatment means.

Results

Production cost of 1 kilogramme of diet

The expense (N) of generating 1kg of each diet with cinnamon powder for African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) is detailed in Table 3. The cost of producing 1 kg of the diet increased with the greater quantity of cinnamon powder used.

Table 3: Cost (₦) of production of 1kg of the experimental diets containing cinnamon

Ingredients	Cost/kg	CTR	DT2	DT3	DT4	DT5
Fishmeal@72%cp	1100.00	305.80	305.80	305.80	305.80	305.80
SBM@44% cp	270.00	120.15	120.15	120.15	120.15	120.15
Yellow Maize@10%cp	250.00	10.00	10.00	10.00	10.00	10.00
Cinnamon	6500.00	0.00	32.50	65.00	97.50	130.00
Fish Premix	600.00	30.00	30.00	30.00	30.00	30.00
Fish oil	1650.00	41.25	41.25	41.25	41.25	41.25
Soy Oil	675.00	16.88	16.88	16.88	16.88	16.88
Starch	500.00	68.50	66.00	63.50	61.00	58.50
Cost/kg Feed		592.58	622.58	652.58	682.58	712.58

Analysis of the costs associated with the production of African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) using diets supplemented with cinnamon powder

Table 4 presents the incidence of a cost analysis (IOC) for producing 1 kg of fish utilising experimental diets that include cinnamon powder, administered to African catfish hybrid fingerlings. The end weights of fish from cinnamon-based diets were numerically greater than those from the control group. However statistical similarity (P>0.05) was seen between them. Nonetheless, substantial changes (p<0.05) were observed in the cost analysis of producing 1kg of fish with the various experimental diets. The incidence of cost escalated with higher levels of cinnamon inclusion in the diet, with the DT5 group exhibiting the highest cost incidence, which was substantially higher (p<0.05) than that observed in other dietary treatment groups. No significant difference (p>0.05) was seen between the costs incurred for fish fed CTR and those fed DT2. The profit index for fish production and the profit per kilogramme of fish produced exhibited significant differences (p<0.05) among the various dietary treatment groups. The CTR-fed group achieved the highest results, while the DT5-fed group achieved the lowest results. No significant difference (p>0.05) was seen between the profit indices of fish produced by CTR and DT2.

Table 4: Incidence of a Cost Analysis of Producing African Catfish Hybrid (*Clarias Gariepinus* ♀ X *Heterobranchus Bidorsalis* ♂) with Diets Containing Cinnamon Powder

	Control	DT2	DT3	DT4	DT5
Final Weight of fish ($x10^{-3}$kg)	10.60±0.43[a]	10.33±1.03[a]	11.94±1.43[a]	12.72±1.69[a]	11.25±0.1
Value of Fish Produced (₦)	10.60±0.43[a]	10.33±1.04[a]	11.94±1.43[a]	12.72±1.70[a]	11.25±0.1
Feed Fed ($x10^{-3}$kg)	10.87±0.74[a]	10.66±1.66[a]	12.85±2.23[a]	13.01±1.66[a]	12.80±0.1
Cost/kg feed	592.58	622.580	652.58	682.58	712.58

Cost of Feed Fed (₦)	6.44±0.44^{c}	6.64±1.03^{bc}	8.39±1.45^{abc}	8.88±1.14^{ab}	9.13±0.78
Incidence of Cost (₦)	607.07±29.63^{d}	634.833±40.69^{cd}	692.71±49.30^{bc}	699.39±26.86^{b}	776.60±108^{a}
Profit Index	1.65±0.77^{a}	1.59±0.10^{ab}	1.46±0.10^{bc}	1.43±0.53^{c}	1.29±0.27
Profit/kg fish produced (₦/kg fish)	392.93±29.63^{a}	365.16±40.70^{ab}	307.29±49.30^{bc}	300.60±26.86^{c}	223.39±108^{d}

Row means with different superscripts are significantly different ($p<0.05$) from each other

1 USD= N413.88

Market Price of 1kg fish = N1000

Analysis of costs and returns associated with the production of African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) with experimental diets incorporating cinnamon powder

The cost and return analysis for the production of African catfish hybrid (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) fingerlings utilising experimental diets with cinnamon powder is detailed in Table 5. No significant change ($p>0.05$) was seen in the biomass produced. The biomass generated with DT4 was the highest, whereas DT5 yielded the lowest. The total cost of producing fish with CTR was the lowest. However, there was no statistical difference ($p > 0.05$) in total costs across the dietary treatments. The gross margin and net profit diverged from total cost: fish produced by CTR achieved the highest profit margin and net return. The gross margin and net return diminished in the cinnamon-treated dietary groups compared to the control group, although exhibited statistical equivalence ($p>0.05$) to the control group.

Table 5: Cost And Return Analysis of Producing African Catfish Hybrid (*Clarias Gariepinus* ♀ X *Heterobranchus Bidorsalis* ♂) with Experimental Diets Containing Cinnamon Powder

	Control	**DT2**	**DT3**	**DT4**	**DT5**
Biomass produced (kg)	10.60±0.43[a]	10.33±1.03[a]	11.94±1.43[a]	12.72±1.69[a]	11.25±0.16[a]
Total Revenue (₦) x10^3	10.60.01±0.44[a]	10.33±1.04[a]	11.94±1.43[a]	12.72±1.70[a]	11.25±0.16[a]
Cost of Feeding (₦) x10^3	6.44±0.44[a]	6.64±1.03[a]	8.39±1.45[a]	8.88±1.14[a]	9.13±0.78[a]
Total Variable Cost (₦) x10^3	6.83±0.44[a]	7.03±1.03[a]	8.78±1.45[a]	9.271±1.14[a]	9.52±0.78[a]
Total Fixed Cost (₦) x10^3	1650±0.00	1650±0.00	1650±0.00	1650±0.00	1650±0.00
Total Cost (₦) x10^3	8.48±0.44[a]	8.68±1.03[a]	10.43±1.45[a]	10.92±1.14[a]	11.17±0.08[a]
Gross Margin (₦) x10^3	3.77±0.33[a]	3.30±0.70[a]	3.16±0.37[a]	3.45±0.70[a]	2.24±0.23[a]
Net Return (₦) x10^3	2.12±0.33[a]	1.65±0.07[a]	1.51±0.37[a]	1.19±0.70[a]	0.59±0.23[a]

Row means with different superscripts are significantly different ($p<0.05$) from each other.

Profitability assessment of cultivating African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) utilising experimental diets supplemented with cinnamon powder

The economic study of producing hybrid African catfish (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) using diets supplemented with cinnamon powder is detailed in Table 6. A substantial difference ($p<0.05$) was seen in the

Benefit-Cost Ratio (BCR) and Rate of Return (ROR) associated with the various dietary regimens for fish production. CTR exhibited the highest BCR and ROR values, whilst DT5 displayed the lowest. No substantial variations ($p>0.05$) were seen in the BCR of fish fed the control and cinnamon-treated diets, with the exception of DT5. The gross ratio (GR) exhibited a divergent trend compared to the benefit-cost ratio (BCR) and Rate of Return (ROR). No significant differences ($p>0.05$) were seen in the expense structure ratio of fish generated under different dietary regimens.

Table 6: Profitability Analysis of Producing African Catfish Hybrid (*Clarias Gariepinus* ♀ X *Heterobranchus Bidorsalis* ♂) with Experimental Diets Containing Cinnamon Powder

	Control	DT2	DT3	DT4	DT5
Benefit Cost Ratio	1.25±0.43^{a}	1.19±0.20^{a}	1.15±0.42^{a}	1.15±0.50^{a}	1.05±0.02^{b}
Gross Ratio	0.80±0.03^{b}	0.83±0.02^{a}	0.86±0.32^{a}	0.87±0.04^{a}	0.95±0.02^{a}
Expense Structure Ratio	0.19±0.01^{a}	0.19±0.02^{a}	0.16±0.02^{a}	0.15±0.01^{a}	0.14±0.001^{a}
Rate of Return	0.25±0.04^{a}	0.19±0.02^{a}	0.15±0.07^{a}	0.16±0.05^{a}	0.05±0.02^{b}

Row means with different superscripts are significantly different ($p<0.05$) from each other

Discussion

The research employed biomass production, economic viability, and profitability as metrics to assess the economic feasibility of integrating cinnamon into the practical diets of African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂). The principal nutritional categories of fish demonstrated a significant response to feeding. The increased biomass seen in the cinnamon-based dietary groups compared to the control group may be attributed to the bioactive constituents in the feed, which could stimulate the gustatory and olfactory nerves of fish consuming cinnamon-enriched diets, as suggested by Pallaya-Baleta et al. (2021). Our results mirrored those reported by Habiba et al. (2021), who fed European sea bass (Dicentrarchus labrax) a cinnamon-based diet. Abdel-Tawwab et al. (2018) documented a beneficial

growth-enhancing effect of dietary cinnamon nanoparticles on Nile tilapia (Oreochromis niloticus), consistent with the findings of this investigation. The inclusion of cinnamon in the diet elevated the cost per kilogramme of the experimental diets, resulting in diminished profit margins for the groups that received cinnamon. This contrasts with our previous findings about the economic analysis of substituting basic feed ingredients for protein sources (Jimoh et al., 2015; Jimoh et al., 2020; Jimoh et al., 2019). Cinnamon serves a fundamental role as an additive in diets; its dose-dependent increase will significantly affect the cost per kilogramme of feed produced and the cost of producing one kilogramme of fish, as the variable production costs rise with higher levels of cinnamon inclusion in the diet. Nevertheless, all dietary treatments resulted in a profit index over 1, indicating the profitability of feeding African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) with cinnamon-based diets. Nonetheless, the profit index and profit per kilogramme of fish produced diminish with the increasing incorporation of cinnamon. The mean total variable cost and the overall cost of producing African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) with diets featuring different inclusion levels of cinnamon were offset by the total revenue generated from the sale of these hybrids, leading to a favourable gross margin and net returns across all dietary treatment groups. A positive gross margin and net returns indicate profitability in feeding (Jimoh et al., 2015). The diminished gross margin and net return in the experimental dietary treatments relative to the control were attributable to the supplementary expense of cinnamon incorporation in the diet of African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂), rather than inferior growth performance. This suggests that, despite substantial evidence supporting cinnamon's growth-promoting properties, the economic implications of its dietary inclusion may not justify its use. As the concentration of cinnamon increased, the BCR and ROR diminished A larger Benefit-Cost Ratio (BCR) indicates greater profitability; the further it deviates from 1, the more profitable it becomes. All dietary interventions produced fish with a BCR exceeding 1. The incorporation of 20g/kg of cinnamon resulted in reduced growth. The diminished palatability of the feed at a greater cinnamon inclusion level (20%) may account for the observed reduction in growth. This aligns with the findings of Habiba et al. (2021).

Conclusion

This study's findings indicated that including cinnamon into the diets of African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) is economically feasible. In addition to its growth-promoting properties, the cinnamon powder was an economical supplement. The incorporation of cinnamon presented several disadvantages, including its high cost. Consequently, incorporating a higher level is not economically feasible. Future experiments may explore additional techniques to lower the cost of cinnamon for incorporation into the diets of the African catfish hybrid (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂). Reduced concentrations of cinnamon powder (0.5g/100g) in dietary formulations appear to yield economic yields similar to those of the control group.

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CHAPTER THIRTY-ONE

Empowering Sustainable e-Commerce through Digital Education: Bridging Knowledge Gaps for Green Consumerism

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Abstract

Digital education is crucial in promoting sustainable e-commerce since it enables consumers and businesses with the knowledge required in green consumerism. This research filled knowledge gaps regarding ethical consumption and environmentally-friendly business operations via the utilisation of digital education. Secondary data was used to evaluate the effectiveness of digital literacy projects and sustainability-oriented learning platforms. The results indicated that although digital infrastructure is growing, there is lack of sustainability-related material within the digital education in mainstream. The inclusion of such materials, especially by using the AI-based and locally based modes of learning, can greatly promote the awareness of green consumer behaviour and sustainability of supply chains. The research illustrated that policy formulation, curriculum exchange, and local area centered interventions are necessary tools that can enable communities to obtain the digital assessments necessary to support responsible e-commerce.

Keywords: Digital Education, Eco-Friendly Business Practices, Green Consumerism, Sustainable e-Commerce.

Introduction

Over the past twenty years, the world of e-commerce has been changing more rapidly as a result of sky-soaring digitalisation rates, shifts in consumer behaviour, and mobile technology. With the growth of digital marketplaces, the negative impact on the environment also increases, which raises the question of whether online commerce is sustainable. Neither over packaging and energy-demanding logistics nor environmental impact of fast fashion and technology consumption can be neglected, and the consequences of e-commerce on nature are numerous and complicated (Mangiaracina et al., 2015; Lim et al., 2021). To

this end, there has been an increasing uprising of the demand to have sustainable e-commerce as a paradigm which aims at ensuring that the digital retailing business is brought in line with the environmental, social and economic sustainability pursuits. Yet, throughout the process of switching to sustainable models, it is not only the underlying change of systems in supply chains and businesses but also an informed and ecologically conscious consumer that is required. Here digital learning comes in to play.

Green consumerism can be defined as the inclination of consumers to make purchasing choices based on the environmental factors that include biodegradability, eco-labeling, and responsible sourcing. This measure has risen in popularity through the previous 10 years, especially amongst younger, digitally natural populations that require convenience in addition to the conscience in their consuming behaviours (Johnstone & Tan, 2015). Online stores now feel the pressure to provide environmentally friendly substitutes of products and evidence on their green statistics. The availability of such options however does not always translate into uptake. Evidence indicates that the inability to be aware of what is supposed to be branded as a green product, the presence of a disunity in labeling to consumers, a general lack of environmental literacy along with other economic inducements are some of the leading reasons as revealed by research why consumers fail to gain a clear understanding of what it entails to make a product be seen to be green (Testa et al., 2020).

Such disconnect necessitates the educational strategy relying on the use of digital tools to increase consumer knowledge. Online education, campaigning on social media, gamifying sustainability, and eco-influencer platforms can be an essential part of the process of shaping behaviours and instilling sustainable principles (Hessel barth &Schaltegger, 2014). These platforms can also support scalable, inclusive, and context-specific educational interventions, particularly in developing economies where the traditional channels of education could be unavailable.

Governmental, academic, NGO and corporate e-commerce collaboration is however key in development and sharing of effective learning content. Such multi-stakeholder model renders credibility, relevance and scalability of green

education initiatives. The bottom line is that providing consumers with knowledge about sustainability not only encourages them to make greener decisions but also makes the companies innovate, compete, and offer environmentally-friendly products and services. The intersection of the two realities stimulated by climate urgency and the digital revolution, sustainable e-commerce, and green digital learning is the much-needed channel of change. With consumers and business interacting more and more with the online platforms, there is a critical need to integrate sustainability knowledge into digital environments.

Nonetheless, although there is an increasingly diverse international literature pointing out the positive relationship between digital literacy and sustainable behaviours, there are still some research gaps that exist in India (especially in semi-urban and rural districts, such as Ara in Bihar). The majority of the available literature, including those in China and Taiwan (e.g., Zhai et al., 2024; Chen et al., 2024; Lin & Huang, 2023), have strong empirical support on the implications of the digital skills to green behaviour through various ways such as ecological cognition, and self-efficacy, and innovation capability. Nevertheless, a similar study has been conducted in India, mostly among urban dwellers or generational cohorts who mainly cover Gen Y and Z in rural cities (Ghouse et al., 2024), So, there is a major gap in viewing how digital literacy promotes sustainable behaviour in rural or low-income areas. There is another large gap in curriculum and pedagogical content of digital education projects. Although some initiatives have been successful in enhancing digital inclusion, they tend to overlook the concept of sustainability (at least locally) to the extent of training digital inclusion modules at a district or grass-root level. In addition, integration of AI powered teaching technologies with the awareness of sustainable business practices in India is poor. Even though in other regions we have evidence that AI tools, such as predictive models, gameplay modules, and personalised learning systems, may be employed to increase the sustainability of supply chains and engagement in the student bodies (Teixeira et al., 2025; Mokhtar et al., 2023), the usage of these technologies and capabilities is still low within the sustainability education and e-commerce industries. That implies that there is a high-level research and implementation

gap between the concept of using AI to enhance the personalisation of green consumer education and expand awareness levels within regional economies.

Lastly, in spite of the continuous efforts on the digitisation mission, the policy framework of digital literacy is still not localised, especially in learning sustainability. A majority of digital skilling efforts fail to internalise eco-literacy or ethical consumerism among the central elements, thus compromising a chance to develop the capacity to engage in a sustainable lifestyle at the local levels. Educational policy and digital training should be reconsidered so that it would suit the sustainability objectives, particularly in sectors that are underrepresented. This study addressed these white spots by analysing the way digital education (enriched with the content supporting sustainability and intelligence-based customisation) could help to empower consumers and small business owners to embrace green e-commerce. As it aimed at providing insightful work towards scholarly explanations it provided a significant contribution based intervention towards effective policy applications that could facilitate sustainable digital change in underserved areas in India.

Thus, this study examined the role of digital education (especially in the setting of such regions as Ara district of Bihar, India) to overcome major knowledge gaps limiting the implementation of green consumerism and an environmentally friendly business strategy. Based on the secondary sources of data (industry insights and academic studies), the study drew attention to the prospects of the sustainability-driven digital literacy, AI-facilitated learning tools, and policy intervention in facilitating ethical consumption and the involvement of green supply chains.

Research Objectives

1. To examine the role of digital education and how it can be used to increase understanding and awareness of green consumerism by consumers and small businesses in Ara, Bihar.

2. To determine how the introduction of sustainability-oriented courses and digital literacy courses may close the knowledge gap and conduct eco-friendly commerce practices through e-commerce.

3. To investigate how AI based learning platforms and individualised digital methods of education can be used to promote responsible consumption and sustainable supply chain knowledge.

Literature Review

Digital Literacy and Pro-Environmental Behavior

The paper by Hu and Meng (2022) reported two studies that addressed similar issues relating to the role of digital literacy in enhancing green consumption through psychological mechanisms based on social cognitive and self-regulatory roles. The presence of green products was found to increase some of these psychological responses, which support pro environmental decisions. Zhai et al. (2024) examined how having the digital literacy would influence the behaviour of farmers to green production technology in China. Ecological cognition was noted in mediation analysis as a key mechanism that brings digital ability into long-lasting practice (Zhai et al., 2024). In addition, a research in Hainan Province, China (Chen et al., 2024), showed that elevating digital literacy is quite substantial in enlarging eco- friendly policy cognition in the rural population and participation in engagement in eco- friendly activities.

Digital Education and Sustainability in University Contexts

Lin and Huang (2023) investigated the connection between the digital ability and sustainable behaviour of university students in Taiwan. Based on the findings of two case-study samples (students of tourism/hospitality and leisure/recreation), it was established that employability skills, innovation capability, information sharing and involvement are the mediators that could attenuate the relationship between the digital capability and the sustainability behaviour. Such mediators were different concerning different subjects of academic study but they all demonstrated the importance of digital education in promoting sustainable attitudes and practices. The study of Trakoonsanti and Abbas (2025) explored the contributing factors of educators, policymakers, and

teachers of Thailand regarding the influences of TAM and TPB models to determine that environmental awareness, green consumption motivation, perceived usefulness of the digitalised tools, and sustainability knowledge all had a positive effect on green consumer behaviours. A combination of these constructs translated digital interaction to eco conscious behaviour (Trakoonsanti& Abbas, 2025).

AI, Supply Chain Management, and Sustainability Education

A systematic review was carried out by Teixeira, Ferreira, and Ramos (2025) regarding adding Artificial Intelligence to supply chain management. They also examined the major roles of AI in predictive analytics, optimisation and traceability, and stated that explainable AI and digital twins are significant ones in the development of supplying chains sustainability. But barriers to adoption are legacies systems, and data issues and ethics (Teixeira et al., 2025). As shown in the study conducted by Jahin et al. (2023), the current situation with AI/ML models in predicting supply chain risks suggests that the new methods such as XGBoost and hybrid models can considerably enhance the predictive accuracy and robustness of logistics risk prevention.

Educational Technology for Sustainability Learning

Sustainable supply chain management education was also addressed in a study by Mokhtar, Sundram, and Shahrom (2023) which focused on ways in which the process of teaching could be gamified and imbued with augmented reality, as well as which modules to teach people with the assistance of AI. They also registered much more engagement and retention of learners in immersive, interactive educational technology than in static engagements (Mokhtar et al., 2023).

Thematic Synthesis and Identified Gaps

Theme	**Key Insights**	**Gaps Identified**
Digital Literacy → Green Behavior	Consistently positive effects mediated by ecological cognition and self-efficacy	Few studies in semi-urban/rural India

Interface Nudges in E-commerce	Environmental information nudges boost sustainable decisions	Lack of Indian/Bihar focus on UI interventions
AI in Supply Chains	Emerging tools boost efficiency and traceability, but require ethical/governance frameworks	Limited integration of digital literacy & skill-building
Digital Education Models	Smart EdTech (IoT/AR/gamification) dramatically improves sustainability knowledge	Need for scalable models in developing regions (e.g., Bihar)
Digital Inclusion Platforms in India	National portals enhance access to learning but lack sustainability-specific courses	Need curricular inclusion for green consumerism in district-level programs

Research Methodology

This study used secondary data-based research approach to find out the role of digital education in the fostering of sustainable e-commerce and green consumerism. The source of data contained government reports, policy paper, academic journal articles, white papers published in the industry, and analytics of digital education platforms in the context of digital literacy and sustainable practices. The insights in these sources were synthesised in a qualitative content analysis format in which patterns, gaps, and correlation between the digital education initiatives and eco-friendly consumer behaviours are identified. This approach facilitated the explication of the context within which available digital framework and educational interventions are manifested in moderating sustainable online shopping and business activities of rural and semi-urban Indian environment.

Data Analysis

This comes out as a detailed analysis to determine the impact of digital education in sustainable e-commerce and development of green consumerism.

Green consumer awareness and Digital Education

Digital literacy in the context of India is also more and more considered as a baseline requirement to participate in the civic life of a country, economic life and environmental awareness. Digital literacy has been limited by such challenges as inadequate access to devices, connection, and the appropriate learning materials in semi-urban and rural places. When environmental literacy is integrated in digital learning, its impact can considerably change consumer awareness about green consumerism (Hu & Meng, 2022). Nevertheless, this is an untapped potential in the Indian rural areas. The district-level economies have a low level of consumer awareness of concepts, including ethical consumption, environment labelling, and reduction of carbon footprints (Confederation of Indian Industry [CII], 2022). The lack of organised digital curricula that can cover these themes creates a continuous knowledge gap on the side of consumer and small-scale internet retailers. There is an increasing role of social media in forming the popular perspectives on sustainability. Informal learning becomes Twitter, YouTube, WhatsApps, and local content-based applications. Yet, how reliable and factual sustainability information is on these platforms is highly diverse. Although such outreach mediums are effective in reaching out to consumers on a greater scale, they are not well poised to change consumer behavior because there are no standardized, evidence-based digital learning materials in place (Vaidya & Kumar, 2025).

Integration of Sustainability-Focused Content in Digital Literacy Programs

Digital education platforms on a national level provide a comprehensive access to open-access education resources. Environmental awareness is normally covered within an overall science course or environmental science course, and it is going to include the topics like e-commerce, green consumerism, etc. Digital education focuses on the infrastructure development as the provision of smart classrooms and digital devices at the expense of a dedicated curriculum on sustainable digital practices. As a result, learners are inadequately prepared to make informed decisions associated with sustainable consumption, ethical sourcing, or circulating e-commerce services. The disconnection between digital literacy and sustainability education is further increased by the absence

of the specific intervention at the local level. The other reports also highlighted the role of providing digital skills to small and medium enterprises (SMEs), which come with the sustainability perspective.

AI-Driven Learning Platforms and Personalized Education for Sustainability

Artificial intelligence (AI) is transforming the education field with personalised learning platform, customised content delivery, and intelligent feedback mechanism. Although some other digital platforms have adopted AI to improve learning performance, little use has been applied to integrate sustainability related content into these systems (Teixeira, Ferreira, & Ramos, 2025). The use of AI-based personalisation is focused mostly on test preparation or skill development in such areas as mathematics and science, whereas the promotion of behavioural learning in terms of sustainability is rather narrow. The world-wide research has also demonstrated that AI can be effective in raising sustainability awareness once the schools use such environmental data in educational algorithms (Hasan, 2024). AI also has a potential in training the local businesses on sustainable supply chaining practices.

Implications for Policy and Practice

The analysis implies a multipronged plan in order to empower sustainable e-commerce with the help of digital learning. The priority of policymakers in ensuring sustainability literacy needs to be embedded in developing the current digital training programs and be customised by regions and inclusive. EdTech platforms should be pushed to integrate environmental themes in their main products, and AI should be used to implement adaptive and personal recommendations of the content. In the conversion of high level environmental ideas to local practice, NGOs and community educators can be important players in this initiative as they help both consumers and small enterprise owners.

Finally, a combination of digital education or a digitally powered learning experience, sustainability awareness, and technological advancement hold the potential solution to encouraging responsible consumption in India. But to create this possibility, we must go out of our way to redesign educational

content, delivery systems and institutional structures that will shape the future of e-commerce and online learning.

Findings

The study analysed how digital education may advance sustainable e-commerce and narrow knowledge gaps in terms of green consumerism. The key findings presented in the background of the three research objectives create crucial understanding of the interdependence between digital literacy, sustainability education, and responsible consumer behavior.

Digital Education and its role in Green Consumerism

The results showed that online learning can certainly be of great value in building and maintaining environmental awareness and consumer environment-friendly behaviour. Nonetheless, this potential has not been used fully utilised in the semi-urban and rural areas. Although initiatives at the national level have helped in enhancing the basic digital literacy, the initiatives are not mostly sustainability-oriented. The subjects like the environmental decision-making, sustainable product choice, an ecological effect of online consumption are not addressed to learners very often. In addition, the prevalence of unstructured digital contents on social media frenzies such as YouTube and WhatsApp indicates that casual avenues are molding the mindset of the people. However, there are no quality controls; hence no evidence-based content to the material to make it educationally viable in promoting change of behaviour. It is evident that the basic digital access does not yet coincide with the level of informed, sustainability-oriented digital engagement that the environmental issue needs to engage in building the green consumerism.

The blending of Digital Education on Sustainable Modules is Insufficient

The most significant gap, which was found in this study, consists in the presence of little sustainability-related content that would be integrated into the mainstream online educational platforms. A majority of the modules offered in terms of sustainability are only theoretical, generic or found in many college programmes in environmental-related sciences, and do not hold application to online buying or green business establishment. Such absence of contextualised and actionable content does not enable learners to attain competencies and take

useful challenge in an enduring digital economy. The study indicated that neighborhood participation and local models can help to make sustainability education less abstract and less theoretical, and more practical.

AI for Environmental Literacy: The Need for Better Integration

Artificial Intelligence (AI) and adaptive learning platforms have transformed the field of delivery of education across a number of areas and their use to sustainability education in India could be more beneficial to all members of society. These platforms have a lot of potential to bring more of a green consumer, or digital ethic, or environmental values into their adaptive learning framework. Though AI is gradually finding its way on the functional fronts in India, especially in the field of agricultural traceability and supply chains optimisation, the innovations have been mostly business based. An opportunity to develop potentially revolutionary potential of holistic sustainability learning could be opening educational facets of these tools. The feather between commercial uses of AI and educational settings would meld the systems towards a more coherent system- a more substantive and pragmatic knowledge of sustainability in the various learning communities.

No Combination of Digital Literacy and Sustainability Goals is Presented in Policy Frameworks

Fragmentation between the digital literacy policies and sustainability education is another important finding. Every nation and state tends to approach these separately as separate entities, and thus opportunities to achieve synergy are also missed. Whereas there has been an increased appreciation by most parts of the globe, sustainability as a fundamental digital competency, the educational policy is yet to respond to this inclusion in rural areas. It is encouraging that the state policy documents have concentrated greatly on digital accessibility and ground training as a major stride to digital empowerment. Nevertheless, it is still a great opportunity to complement these activities with adding the awareness of the environment and the ethics of a good consumer to the set of core learning outcomes. At present, the lack of direct policy and curriculum requirements of digital skills training in undertaking sustainability education translates to a variant of digital literacy whose proficiency in technology is

informative, but yet remains ignorant of environmental awareness. Combining the two issues of digital empowerment and environmental stewardship by filling this policy gap gives a significant chance to make the evolution of a more comprehensive and wider-lensed model.

Localised, Culturally Relevant Content Is Essential for Impactful Learning

The study underlined that specify-related and culturally relevant content enhances participation and understanding between learners to a large extent. The problem with generic digital content is that it does not appeal to learners in semi-urban and rural regions. On the other hand, if the sustainability education is provided in local languages with scenarios, which are close to the learner, it can help him or her internalises the skill and applies it. It is significant to decentralise content development, engage the local educators, NGOs, and learners in co-designing sustainability curriculum. Top-down, one-size-fits-all methods have less potential to effect behaviour change than community-based models that rely on deceptively simple, technology-friendly languages and local case studies of success. This means that green consumerism awareness needs to be embedded on the socio-cultural context of the learners in particular regions.

Conclusion

The study examined the interplay between digital education and sustainable e-commerce, which has been found to be an interesting and quite complicated sphere of study and practice with a narrower focus on the district of Ara in Bihar, India. The main assumption that digital education may become an effective instrument in knowledge transfer in the question of green consumerism was explored with the help of an in-depth analysis of secondary data, which provided the idea of current drawbacks, future opportunities, and the course to go. The study concluded that though there has been enhancement of digital infrastructure and access due to national programmes, policy and support, integration of sustainability related content and courses into digital learning ecosystems are seriously lacking. Even digital literacy may still be mainly functional in its focus in rural and semi-urban areas, failing to reach the level of conceptual knowledge or situational applicability to create

environmental responsibleness in behaviours. This indicates a huge gap between technology access and its capability of making sustainable decision-making. As it has been noted so far, although some of the biggest educational platforms cover the issue of environmental literacy, much can be done to make such material richer and more practice-based. These platforms can provide an effective way to deal with the issues affecting the real world such as daily online shopping, ethical shopping, and conscious consumption, etc. The role of Artificial Intelligence in facilitating sustainability education can be exploited to a great extent. The AI-powered software has already shown impressive progress in providing individualised academic experiences, and there is a good potential in taking into consideration the concept of sustainability. The new generation shopping interface based on environment rating, and adaptive green learning tools, present a useful guideline on future developments in this field. The lack of tools, especially in rural areas, provides an insight into a potential opportunity to create and deploy new AI-based tools devoted to teaching sustainability. This study, in the framework of policy analysis, noted the necessity of closing the existing gap between digital literacy and sustainability concerns that are usually discussed independently both in educational policies and governance. The combination of these areas can play a leading role in revealing the effectiveness of empowering people through digital methods. A broader-based and more interdisciplinary policy that would treat sustainability as a pillar of digital citizenship can be developed to support a more comprehensive and future-forward growth in the learning outcomes of the whole of India. In the real sense, the road map to the sustainable e-commerce in India should always be inclined towards technology but also reformative education. Online learning should also become an instrument of awareness, agency, and action as opposed to access. Such shift is especially acute in such districts as Ara as the digital infrastructure is being developed, and the educational material is not up to date with the social-environmental problems of the 21st century any longer. Through identification of these gaps and opportunities, this study added to the academic discussion and provided practical guidelines that can be pursued by policymakers, educators, and technologists. Sustainable digital education of the consumers and the business cannot be just a developmental requirement but also an indispensable measure

to ensure inclusive, resilient and clean green development of the digital economy of India.

Limitations

Although this study provided many significant details about the position of digital learning in supporting the emergence of sustainable e-commerce and the promotion of green consumerism, it had its own drawbacks. The study relied exclusively on the availability of secondary information including policy reports, literature publications, and industry reports; and hence would not account the life experiences and behavioural peculiarities of local consumers and businesses as well as real time perceptions. The lack of primary data gathering limited the possibility of proving the results with the help of directly asking questions from the stakeholders to specify recent changes in the digital habits. Further, limited generalisability of the results can be also attributed to the specific socio-economic and cultural peculiarities of the region that are unlikely to apply to the rest of the districts. The dynamically changing character of the digital technologies and sustainability models also implies that some of the mentioned platforms or initiatives can radically get changed, which may influence the applicability of the study in the long-run.

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CHAPTER THIRTY-TWO

Navigating Cultural Diversity in Globalised Education Systems: An Empirical Analysis of Leadership Practices among Student Unions

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Abstract

As education becomes increasingly globalised, higher institutions have become a hub for cultural exchange where individuals from different cultures, languages, and ethnic groups interact. In addition to academics, the institutions are places where students from many backgrounds can share their perspectives and experiences. Against this backdrop, educational leaders face the complex challenges of navigating diversity and fostering inclusivity where academic excellence thrives. This study employed a descriptive survey research design, focusing on undergraduate students at Al-Hikmah University. A sample of 200 students was selected from the population of 6,852 undergraduate students at the institution through simple random sampling to gather insights into their perceptions of the influence of culturally responsive leadership on student union leaders' practices. Data were collected using a structured questionnaire titled "Culturally Responsive Leadership and Students' Participation Scale" (CRLSPS). The analysis involved descriptive statistics to summarise the data and inferential statistics, including regression analysis, to test the formulated hypotheses at a 0.05 significance level. Findings revealed that student leaders demonstrated a high level of culturally responsive leadership, with an overall mean score indicating effective cultural awareness and inclusive practices, as well as high participation in various campus activities. Based on the findings, the study recommends that universities implement training programs focused on culturally responsive leadership to equip student leaders with the skills needed to foster inclusivity. Additionally, institutions should create supportive environments that encourage active participation from all students, ensuring that campus activities reflect the diverse cultural identities of the student body.

Keywords: Inclusiveness, Globalisation, Culture, Leadership practices.

Introduction

Education is a crucial foundation for both personal and societal development. It is not just about academic success; it involves the overall development of individuals, preparing them to actively participate in their communities and make positive contributions (Santamaria & Santamaria, 2016). In this regard, education serves as a bridge between individual aspirations and societal progress, shaping future leaders and contributors to economic, social, political and cultural development. According to the National Policy on Education, one of the primary objectives of higher education in Nigeria is to promote national unity. This implies that education should bring together students from different cultural, social, economic and religious backgrounds. Nigeria is a deeply multicultural society, home to over 250 ethnic groups and a range of religious traditions. This diversity is both a strength and a source of tension, as historical conflicts and socio-political divisions have shaped the country's educational landscape. However, this diversity often brings about challenges, including intergroup tensions, cultural misunderstandings and systemic inequalities (Brown et al., 2022). Institutions of higher education are microcosms of the broader society, reflecting its complexities and challenges. The presence of students from varied backgrounds creates a unique opportunity for dialogue and collaboration, but also necessitates intentional efforts to address cultural sensitivities and foster unity. Higher education institutions serve as a melting pot for diversity, creating opportunities for understanding and collaboration among young Nigerians (Johnson & Fuller, 2015).

Effective leadership within these institutions is critical for harnessing the potential of diversity. Student leaders play a vital role in shaping campus culture, advocating for inclusivity, and addressing the unique needs of their peers. According to Khalifa et al (2016), leadership in a multicultural environment requires not only awareness of cultural differences but also a commitment to equity and respect for all individuals. In Nigerian tertiary institutions, where students often encounter cultural differences for the first time, student leaders have the responsibility to model inclusive behaviour and create spaces where everyone feels valued through activities that actively engage students with the experiences of diverse groups and implement practices that promote fairness and inclusivity. Frawley et al (2020) argue that culturally responsive leaders are proactive in addressing disparities, ensuring that all voices are heard and that every student has the opportunity to succeed.

This is particularly important in Nigeria, where socio-economic inequalities and cultural biases can marginalise certain groups. For instance, a culturally diverse classroom may lead to richer discussions and more comprehensive problem-solving approaches. However, these benefits can only be realised if institutions actively address the challenges associated with diversity.

Culturally responsive leadership is a critical aspect of educational leadership that emphasises understanding and valuing diverse cultural backgrounds in educational settings. According to Ladson-Billings (2020), culturally responsive leadership involves recognising the cultural strengths and assets of students from diverse backgrounds and using this knowledge to inform decision-making and practices within educational institutions. This approach is rooted in the belief that culture plays a significant role in shaping students' identities, experiences, and academic success. Culturally responsive leadership involves recognising, respecting, and valuing the diverse cultural backgrounds and experiences of individuals within an educational community. In a multicultural society, university students need to develop culturally responsive leadership skills to effectively engage with diverse populations and promote social justice. This project will focus on understanding how university students in Kwara State perceive and practice culturally responsive leadership in their academic and social interactions.

In the context of universities in Kwara State, Nigeria, culturally responsive leadership plays a crucial role in promoting inclusivity, equity, and academic success among students from diverse cultural backgrounds. Kwara State is known for its rich cultural diversity, with various ethnic groups and traditions coexisting within the region. Therefore, it is essential for university leaders to adopt culturally responsive practices to effectively support and empower students from different cultural backgrounds. Effective leadership is crucial for fostering inclusive and diverse campus environments, promoting student engagement, and enhancing academic success. However, leadership styles and practices can be culturally bound, and cultural responsiveness is essential for effective leadership in diverse university settings (Ladson-Billings, 2020). While much of the literature on CRL comes from Western contexts, its application in non-Western settings such as Nigeria remains underexplored. In the Nigerian context, particularly in Kwara State, there is a pressing need to examine how culturally responsive leadership can be implemented to bridge the gap between students' diverse cultural backgrounds and university

leadership practices. This study seeks to address this gap by exploring the implications of CRL in Kwara State's higher education institutions.

Literature Review

Cultural Competence Theory, updated by Sue et al. (2019), emphasises the necessity for leaders to develop skills to interact effectively with students from diverse cultural backgrounds. Cultural competence involves not only understanding one's own cultural identity but also recognising and addressing cultural differences. Leaders who are culturally competent are better equipped to support diverse students, enhancing both their academic experiences and success (Sue et al., 2019). In practice, culturally responsive leadership involves continuous professional development in cultural competence, the implementation of inclusive policies, and fostering open dialogues about cultural issues. By adopting these theories, leaders in Kwara State universities can effectively navigate the complexities of cultural diversity, creating an environment where every student feels valued and empowered, thereby supporting their academic and personal growth. Theoretical and practical evidence underscores the importance of CRL in addressing challenges posed by cultural diversity in educational leadership. For example, research by Banks (2019) stresses the necessity of preparing students for a multicultural and interconnected world, advocating for leadership practices that prioritise inclusivity and equity. Although each author emphasises different dimensions such as multicultural preparation, systemic equity, or academic success, all studies recognise cultural competence as an essential prerequisite for effective leadership, differing mainly in whether they emphasise its development, application, or contribution to social justice.

This field explores leadership practices that recognise, respect, and integrate students' varied cultural identities, fostering a supportive and inclusive academic environment. The theoretical framework for culturally responsive leadership is based on key concepts emphasising cultural awareness and inclusivity. Effective leadership is believed to be enhanced when leaders engage with the cultural identities of their students, understanding and adapting practices to meet diverse needs. Several contemporary theoretical perspectives shape this framework for culturally responsive leadership in Kwara State. These frameworks guide leaders in engaging with a diverse student body and promoting academic and personal growth. Banks (2019) also noted that leadership practices in higher education must be designed to prepare students

for a multicultural and interconnected world. He suggested that universities should promote inclusivity by ensuring that leadership reflects diverse student experiences and needs. Research by DeAngelis and DeAngelis (2018) corroborates the importance of CRL in promoting positive student outcomes, particularly in terms of academic achievement, retention, and social integration. Geneva Gay (2018) highlights the transformative potential of culturally responsive practices, emphasising their role in creating equitable educational systems. She asserts that CRL involves fostering cultural competence among students and staff while addressing systemic barriers that hinder academic success. Similarly, Ladson-Billings (2020) argues that leaders must incorporate cultural knowledge into their decision-making processes to ensure all students feel represented and supported.

Academic collaboration thrives within a diverse environment. Students from varied backgrounds work together on research projects, leading to innovative solutions and a deeper understanding of complex issues (Ojo, 2019). Furthermore, the linguistic diversity on campus, with languages such as Yoruba and Hausa spoken alongside English, promotes a multilingual environment and enhances communication skills (Ogunyemi, 2021). Universities in Kwara State frequently organise cultural exchange programs and seminars to foster cross-cultural understanding. These events provide opportunities for students to share and learn about each other's traditions (Salami, 2022). Student organisations and clubs dedicated to specific ethnic and religious groups further support this cultural exchange, creating strong networks that enhance both academic and social experiences (Eze, 2020). Cultural diversity also manifests in campus dining and events. Food festivals and cultural nights allow students to experience a variety of cuisines, showcasing Nigeria's culinary richness (Durojaiye, 2021).

Additionally, traditional performances and art exhibitions provide platforms for celebrating and appreciating the diverse cultural heritage of the student body (Akinola, 2021). The presence of international students adds another dimension to campus life, encouraging global understanding and cooperation (Ibrahim, 2023). Moreover, diverse student groups often collaborate on community service projects, integrating cultural insights to address social issues effectively (Musa, 2022). To accommodate and honour this diversity, universities provide facilities such as multi-faith prayer rooms and culturally-themed study areas (Olaniyan, 2022). These amenities ensure that the needs of all students are

respected and met. While Ojo (2019) and Ogunyemi (2021) focus on the academic advantages of diversity, Salami (2022), Eze (2020), and Durojaiye (2021) emphasise cultural exchange through institutional activities and student organisations. Ibrahim (2023) and Musa (2022) further highlight diversity's contribution to global understanding and community development. Together, these studies suggest that cultural diversity becomes an institutional strength when leaders intentionally create opportunities for interaction, participation, and inclusion. Their studies collectively conclude that cultural diversity enriches university life by enhancing learning, innovation, collaboration, and intercultural understanding when supported by inclusive leadership.

According to Ladson-Billings (2020), advocates for the incorporation of cultural knowledge into leadership decision-making processes to ensure all students are represented and supported. Scholars such as Banks (2019) also stress the necessity of preparing students for a globalised, multicultural world by promoting leadership practices that prioritise inclusivity, equity, and social justice. Culturally responsive leadership, derived from the concept of culturally responsive pedagogy, involves those leadership philosophies, practices, and policies that create inclusive schooling environments for students and families from ethnically and culturally diverse backgrounds. Common practices include emphasising high expectations for students' achievement, incorporating the history, values, and cultural knowledge of students' home communities in the school curriculum, working to develop a critical consciousness among both students and faculty to challenge inequities in the larger society, and creating organisational structures at the school and district level that empower students and parents from diverse racial and ethnic communities. Similar terms to describe this approach to leadership include culturally proficient leadership, culturally relevant leadership, culture-based leadership, cultural competency, multicultural leadership, and leadership for diversity. Although there are subtle differences in how authors and researchers employ these different terms, in general, these approaches encourage teacher leaders, school principals and district level leaders to "lead for diversity" and work with teachers, parents, and the larger community to develop curriculum frameworks, pedagogical practices, and organisational structures and routines that are consistent with the cultural orientations of ethnically diverse students and their families. While much of the investigation of culturally responsive practices has focused on classroom teaching, recent efforts have applied a culturally responsive framework to school leadership. Despite using different

concepts and terminology, the reviewed studies converge on the importance of inclusive leadership practices that integrate diversity into institutional structures and decision-making.

In general, these studies characterise culturally responsive school leaders as those who emphasise high expectations for students' academic achievement, exhibit an ethic of care, promote inclusive instructional practices, and develop organisational structures that empower parents and the broader community in the life of the school. Culturally responsive leadership often overlaps with "leadership for social justice" approaches, a term that has been prevalent in the Kwara state educational literature and focuses on improving the educational experiences and outcomes for all students, particularly those who have been traditionally marginalised in schools. While this bibliography incorporates some sources that focus on socially just leadership, it emphasises those school leadership theories and practices that respond to issues of ethnicity, culture, language, and race. Ann E. Lopez (2016) emphasises that culturally responsive leadership is essential for fostering inclusivity and promoting positive change in diverse educational environments. She argues that without cultural competence, students may face difficulties in leading diverse groups, addressing issues related to social justice, and promoting equitable participation among peers. Similarly, Banks (2013) and Nieto (2017) highlight the importance of cultural competence in leadership development, noting that inclusive leadership practices help prepare students to become agents of change, capable of addressing issues such as inequality, discrimination, and social exclusion.

Despite the growing recognition of the importance of cultural responsiveness in leadership, limited research has been conducted on how university students, particularly in Nigerian contexts like Kwara State, perceive and practice culturally responsive leadership. This lack of empirical studies has left a gap in understanding both the specific challenges students face in diverse environments and how these challenges might be overcome through targeted leadership development programs. Furthermore, while universities in Nigeria are increasingly embracing diversity, the absence of a structured framework to address cultural differences within leadership development programs means that many students may lack the skills needed to lead inclusively. As a result, students may miss valuable opportunities for personal and professional growth, and the university community may experience fragmentation and lack of

cohesion, undermining both academic and extracurricular activities. Kwara State is known for its rich cultural diversity, with various ethnic groups and traditions coexisting within the region. Therefore, it is essential for university leaders to adopt culturally responsive practices to effectively support and empower students from different cultural backgrounds. In conclusion, this project will contribute to the existing literature on culturally responsive leadership in higher education and provide practical recommendations for promoting cultural competence and inclusivity among university students in Kwara State. By fostering culturally responsive leadership skills, students can become effective advocates for diversity, equity, and social justice within their academic and professional endeavours. In the diverse academic environment of Kwara State, university students are frequently called upon to assume leadership roles within their academic institutions, often representing a wide array of cultural, ethnic, and socioeconomic backgrounds.

However, a critical concern exists regarding the preparedness of these students to engage in leadership practices that respect and incorporate cultural diversity. Despite the growing importance of leadership in university life, there is a significant gap in the education and training related to culturally responsive leadership. Without this crucial cultural competence, students may encounter challenges in leading effectively, resulting in exclusionary practices, interpersonal conflicts, and diminished team dynamics that negatively affect academic and social outcomes. While leadership development programs in Nigerian universities have focused on skills such as decision-making, communication, and problem-solving, there is insufficient attention given to the integration of cultural diversity into leadership practices among students. This is especially true in Kwara State, where university students come from a variety of ethnic, religious, and cultural backgrounds. The failure to incorporate culturally responsive leadership training in university curricula means that many students may struggle to navigate and lead in a multicultural environment, leading to challenges such as misunderstandings, marginalisation, and a lack of cohesion among diverse student groups.

The literature demonstrates a broad consensus that culturally responsive leadership fosters inclusion, equity, and improved educational outcomes through leaders' cultural competence and inclusive practices. While previous research has extensively examined these issues among school leaders and institutional administrators, there is limited empirical evidence concerning

student union leaders in Nigerian universities. This gap provides a strong justification for investigating how culturally responsive leadership influences leadership practices among student unions in globalised higher education systems. This study seeks to fill this gap by investigating the experiences and challenges of university students in Kwara State regarding culturally responsive leadership. It aims to explore the barriers that prevent students from leading inclusively, identify the key competencies needed for culturally responsive leadership, and propose practical strategies for integrating cultural responsiveness into leadership development programs. By addressing these issues, the study hopes to enhance students' leadership abilities, foster greater inclusivity, and contribute to the development of a more harmonious and productive university community.

Problem Statement

Culturally responsive leadership is becoming increasingly important in higher education as universities face the challenges of growing diversity on their campuses. Despite the importance of CRL, significant challenges remain in implementing such leadership in Kwara State universities. One of the main barriers is the lack of formal cultural competence training for university administrators and faculty. While many leaders recognise the importance of cultural inclusivity, they often lack the skills or knowledge necessary to effectively implement strategies. Another challenge is resistance to change, particularly in institutions where traditional leadership styles are deeply entrenched, making it difficult to adopt new practices that prioritise cultural responsiveness. Additionally, resource constraints present a challenge, as universities may struggle to allocate the funds and personnel needed to support inclusive initiatives. Nevertheless, culturally responsive leadership is essential for ensuring that universities in Kwara State offer an inclusive and supportive environment for all students, regardless of cultural background. Empirical studies show that while there is growing recognition of the importance of cultural diversity, more concrete actions are required to translate this awareness into effective leadership practices. By providing training in cultural competence, developing inclusive policies, and engaging more directly with students from diverse backgrounds, university leaders can create academic environments that are not only culturally inclusive but also conducive to the success of all students.

Unfortunately, many student leaders struggle to develop the skills and frameworks needed to create inclusive environments that genuinely value cultural differences. This gap often leaves marginalised groups feeling isolated, which can significantly affect their sense of belonging and academic success. Research shows that culturally responsive leadership bridges these divides by fostering equity, trust and collaboration. Yet despite its potential, practical implementation among university students remains limited (Mansfield & Lambrinou, 2022). Lack of culturally responsive practices among student leaders can lead to issues such as underrepresentation and biases in decision-making, leading to alienation among minority students. Even though the importance of culturally responsive leadership is widely acknowledged, many universities fall short in providing adequate training for student leaders to develop the necessary cultural competencies. This lack of preparation means that valuable opportunities to harness cultural diversity as a strength in leadership practices are often missed.

Although culturally responsive leadership has gained increasing attention in educational leadership literature, significant gaps remain. Existing studies have largely focused on school administrators and faculty, leaving limited knowledge about how culturally responsive leadership influences leadership practices among university student union leaders. Furthermore, most previous studies have employed qualitative or descriptive approaches, with few using predictive quantitative methods such as multiple regression to examine these relationships. In addition, there is a paucity of evidence from Nigerian universities, particularly in Kwara State, where increasing cultural diversity presents unique leadership challenges. Addressing these gaps is essential for generating evidence that can strengthen culturally responsive leadership practices and promote inclusive student leadership in globalised higher education systems.

Purpose of the Study

The primary purpose of this study is to explore culturally responsive leadership among university students in Kwara State. Specifically, the study will aim to:#

i. I. How often do University students participate in campus activities?

ii. What impact does culturally responsive leadership have on leadership practices?

iii. What is the impact of cultural awareness of student leaders on leadership practices?

Methodology

This study adopted a descriptive survey research design to examine the relationship between culturally responsive leadership and leadership practices among student union leaders in a culturally diverse higher education environment. The descriptive survey design was considered appropriate because it enables the collection of quantitative data from a representative sample of respondents at a single point in time and facilitates the examination of relationships among variables without manipulating the study environment. The study population comprised 6,852 undergraduate students of Al-Hikmah University, Ilorin, Kwara State, Nigeria. A sample of 200 undergraduate students was selected using convenience sampling. The sampling technique was considered appropriate because the study targeted readily accessible students who were willing to participate in the online survey. Furthermore, convenience sampling facilitated timely data collection within the available resources while providing adequate responses for regression analysis.

Data were collected using a structured questionnaire comprising two sections. Section A elicited respondents' demographic information, including gender, age, level of study, faculty, and previous participation in student union activities. Section B measured the study variables using items adapted from Hines's (2022) culturally responsive leadership framework. The questionnaire assessed four dimensions of culturally responsive leadership: inclusiveness, development, validation, and cultivation as the independent variables, while leadership practices constituted the dependent variable. Responses were measured on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). To ensure content and face validity, the questionnaire was reviewed by experts in Educational Management and Measurement and Evaluation, who assessed the relevance, clarity, and adequacy of the items in relation to the study objectives. Their observations informed the revision of ambiguous statements before the instrument was administered.

A pilot study was conducted among students at a university outside the study area who had characteristics similar to those of the study participants. The

internal consistency of the instrument was determined using Cronbach's Alpha. The overall reliability coefficient was 0.83, indicating satisfactory reliability. Participation was voluntary, informed consent was obtained from all respondents, anonymity was maintained, and participants were assured that the information provided would be used solely for research purposes. The questionnaire was converted into a Google Form, and the survey link was distributed through official student communication platforms. Responses were exported from Google Form to Microsoft Excel and into Statistical Package for Social Sciences (SPSS) for analysis.

The demographic characteristics of the respondents were analysed using frequency counts and percentages, while descriptive statistics (mean and standard deviation) were used to summarise responses to the study variables. Prior to the analysis, the data were screened for completeness, missing values, outliers, and data entry errors. The assumptions underlying multiple regression analysis were also examined. Normality was assessed using skewness and kurtosis values as well as a normal probability plot; the results confirmed that the data satisfied the assumptions for multiple regression analysis. Thereafter, descriptive statistics were used to answer the research questions, while multiple regression analysis was employed to determine the predictive influence of the dimensions of culturally responsive leadership on leadership practices among student union leaders. Statistical significance was determined at the 0.05 level.

Findings

Research Question 1: What is the level of students' participation in campus activities?

Table 1: Students' Participation in Campus Activities

S/N	Items	Mean	SD	Decision
1.	I take part in events and programmes organised by my school	3.34	0.64	High
2.	I join clubs, groups or student organisations on campus	3.20	0.75	High
3.	I attend seminars, workshops or talks arranged by the school	3.21	0.77	High
4.	I participate in cultural and social activities at school	3.09	0.80	High
5.	I get involved in sports and fitness activities offered by the school	3.09	0.80	High

6.	I take part in student leadership and decision-making	3.15	0.79	High
7.	I volunteer for school events or service projects	3.13	0.75	High
8.	I help plan and organise activities for other students	3.12	0.79	High
9.	I feel encouraged by the school to join campus activities	3.16	0.79	High
10.	I believe my participation in campus activities helps me learn	3.18	0.76	High

Key: <2.50 = Low, >2.50 = High

Table 1 shows that the level of students' participation in campus activities in Al-Hikmah University was high. Specifically, students agreed that they take part in events and programmes organised by the school, with a mean score of 3.34, they also indicated active involvement in clubs, groups, or students' organisations on campus. Other items also suggest that students are actively engaged in a wide range of campus activities and feel supported by their institutions in contributing to a vibrant campus community.

Research Question Two: What impact does culturally responsive leadership have on students' participation in school activities?

Table 2: ANOVA on Culturally Responsive Leadership and Students' Leadership Practices

Model		Sum of Squares	Df	Mean Square	F	Sig
1	Regression	5.606	1	5.606	35.459	.000
	Residual	31.304	198	.158		
	Total	36.910	199			

This table presents the analysis of Variance (ANOVA) results used to elevate the statistical significance of the regression model examining the impact of culturally responsive leadership on students' participation in school activities. The regression sum was 5.606, indicating the proportion of variation in students' participation that is attributable to culturally responsive leadership. The model produced f-statistic of 35.459, with a significance value of .000, which is well below the conventional .05. This result indicates that the model is statistically significant, meaning that culturally responsive leadership of

student leaders as a predictor significantly improves students' participation in campus activities. The residual sum of 31.304 represents the portion of variance in students' participation not accounted for by the model. Since the p-value is less than .05, the results provide strong evidence to confirm that culturally responsive leadership has a significant impact on students' active participation in campus activities.

Research Question 3: What are the impact of cultural awareness of student leaders on leadership practices

Table 3: ANOVA on cultural awareness and leadership practices

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.899	1	2.899	16.879	.000[b]
	Residual	34.010	198	.172		
	Total	36.910	199			

a. Dependent Variable: Leadership Practices

This table presents the analysis of Variance (ANOVA) results used to elevate the statistical significance of the regression model examining the impact of cultural awareness of student union leaders on leadership practices in the university. The Analysis of Variance (ANOVA) results were used to assess the statistical significance of the regression model, examining the impact of cultural awareness of student leaders on students' participation in campus activities in Al-Hikmah University, Ilorin, Kwara State. The regression sum of squares was 2.899, indicating the proportion of variation in students' participation that is attributable to cultural awareness. With 1 degree of freedom, the corresponding mean square was also 2.899. The model produced an F-statistic of 16.879, with a significance value ($p = .000$), which is well below the conventional threshold of 0.05. This result confirms that the regression model is statistically significant, meaning that the inclusion of cultural awareness as a predictor significantly improves the model's ability to explain variation in students' participation. The residual sum of squares was 34.010, representing the portion of variance not explained by the model. Given that the p-value is less than .05, the results provide sufficient evidence to reject the null hypothesis. Therefore, it can be concluded that cultural awareness of

student leaders has a significant impact on students' participation in campus activities.

Discussion of Findings

Findings from research question one revealed that students reported a high level of participation in campus activities, with a mean score of 3.18. This suggests that students are actively involved in academic, social, and co-curricular initiatives, indicating a vibrant and inclusive campus culture. The implication of this finding is significant: when students perceive that their identities are respected and their voices heard, they are more likely to contribute to campus life. Rugambuka and Mazzuki (2023) affirmed this by stating that inclusive and respectful environments are catalysts for student engagement and participation. Similarly, Ettekal et al. (2020) argued that culturally relevant programming activities that reflect students' cultural values, traditions, and experiences increase students' sense of ownership and belonging within academic institutions. Adding to this discourse, the findings of Deni Surapto et al. (2024) in a study on inclusive leadership in distance higher education programs revealed that leadership styles that prioritise inclusion and representation significantly enhance both student participation and retention. Their study highlights the relevance of inclusive leadership beyond traditional campus settings, showing its impact in diverse learning modalities. This supports the notion that participation is not solely an outcome of student interest but is deeply influenced by the institutional climate and leadership practices that either promote or inhibit engagement.

Research question two tested hypothesis that specify the statistically significant impact of culturally responsive leadership on leadership practices. The result demonstrates a moderate positive impact of culturally responsive leadership on leadership practices ($\beta = .390$, $p < .001$). This result indicates that students are more likely to engage actively in campus life when student leaders employ leadership styles that respect cultural identities and promote fairness and collaboration. It highlights the critical role of leadership in shaping student behaviour and motivation. This finding is in line with Solis-Grant et al. (2023), who reported that students show higher levels of engagement and institutional loyalty in environments where leadership is inclusive and culturally attuned. Barksdale (2024) similarly emphasised that students feel empowered to participate when they perceive that their leaders are fair, empathetic, and culturally competent. Reinforcing this view, Murwanto (2024) showed that

inclusive leadership across various educational contexts plays a transformative role in ensuring participation and dismantling structural inequities that limit access to involvement for marginalised student groups. Together, these findings imply that culturally responsive leadership should not be viewed as a supplemental trait but as a foundational element of effective student governance and campus development.

Finding from research question three revealed that cultural awareness among student union leaders significantly predicts leadership practices within the university environment. The regression model was statistically significant ($F = 16.879$, $p < .05$), indicating that cultural awareness contributes meaningfully to explaining variations in leadership practices. This suggests that student leaders who demonstrate greater awareness and appreciation of their peers' diverse cultural backgrounds are more likely to adopt inclusive, participatory, and effective leadership practices. The finding underscores the importance of cultural awareness as a critical leadership competency for promoting cohesion and fostering meaningful engagement within multicultural university communities. This finding is consistent with the principles of culturally responsive leadership, which emphasise that effective leaders acknowledge, respect, and integrate the cultural identities of those they serve into leadership decision-making and organisational practices (Geneva Gay, 2018; Gloria Ladson-Billings, 2020).

According to James A. Banks (2019), leaders who possess strong cultural awareness are better positioned to create inclusive environments that promote equity, mutual respect, and active participation among culturally diverse groups. Similarly, Derald Wing Sue et al. (2019) argue that cultural competence enhances leaders' ability to understand diverse perspectives, minimise cultural bias, and foster positive interpersonal relationships, thereby improving leadership effectiveness. The finding further supports Hines' (2022) culturally responsive leadership framework, which identifies cultural awareness as a foundational element of effective leadership in diverse educational settings. Student leaders who understand and appreciate cultural differences are better equipped to resolve conflicts, communicate across cultural boundaries, and make decisions that reflect the interests of diverse student constituencies. Such leadership practices contribute to stronger organisational cohesion and greater participation in university activities. This finding implies that universities should intentionally integrate cultural

awareness into student leadership development programmes. Leadership training should extend beyond administrative and organisational skills to include cultural competence, diversity management, inclusive communication, and intercultural collaboration. Such initiatives would enhance the capacity of student union leaders to effectively navigate cultural diversity and promote inclusive participation within increasingly globalised higher education systems.

Conclusion

This study examined the influence of culturally responsive leadership on leadership practices among student union leaders in Al-Hikmah University, Ilorin, Kwara State, within the context of an increasingly globalised and culturally diverse higher education environment. The findings revealed that students actively participate in campus activities and that culturally responsive leadership significantly enhances effective leadership practices. Specifically, cultural awareness emerged as a significant predictor of leadership practices, demonstrating that student leaders who recognise, appreciate, and respond to the diverse cultural identities of their peers are more likely to foster inclusive, participatory, and collaborative leadership. These findings affirm that culturally responsive leadership is not merely a desirable leadership attribute but an essential competency for promoting equity, mutual respect, and meaningful student engagement in multicultural university settings. The study contributes to the growing body of literature on culturally responsive leadership by extending its application beyond institutional administrators to student union leadership, an area that has received limited empirical attention, particularly within the Nigerian higher education context. By employing a quantitative approach to examine the predictive relationship between culturally responsive leadership and leadership practices, the study also provides empirical evidence that addresses existing methodological and contextual gaps in the literature.

The study concludes that universities seeking to strengthen student leadership should intentionally integrate culturally responsive leadership into student leadership development programmes. Training initiatives should equip student leaders with competencies in cultural awareness, inclusive communication, intercultural collaboration, conflict management, and equitable decision-making. Such efforts will not only enhance the effectiveness of student unions but also promote social cohesion, strengthen students' sense of belonging, and prepare future leaders capable of navigating the complexities of increasingly

diverse and globalised educational environments. This suggests that beyond simply understanding students' cultural identities, student leaders who actively promote equity, shared decision-making, and fair treatment are more likely to foster a vibrant and participatory campus culture. It can therefore be concluded that culturally responsive leadership is not just a value-driven approach but also a practical strategy for enhancing student engagement and fostering community among a diverse student body. Promoting inclusiveness and culturally aware student leadership can improve the social and academic life of students on campus.

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negotiable. Abdul Samat and Abdul Aziz (2020) noted that the use and application of multimedia in learning, teaching, and reading is valuable, as it combines different media elements that greatly aid information processing for adequate and effective understanding.

Irika et al. (2023) opined that multimedia has greatly benefited classroom activities by easing the availability and accessibility of learning materials, benefiting both educators and learners. According to Irika et al. (2023), the use of multimedia packages and facilities via internet media in the learning process has significantly increased students' effectiveness, creativity, and motivation. Similarly, Jastaniyah and Bach (2017) asserted that multimedia is useful for both educators and learners because educators can easily access, download, upload, and share educational materials with students in a short period of time. Similarly, teachers and students can greatly benefit from the application of multimedia for the design and delivery of lectures.

Thus, the teaching and learning process can be effectively enhanced through the use of multimedia elements (Sousa, Richter & Nel, 2017; Abdul Samat & Abdul Aziz, 2020; Irika et al., 2023). However, there are various categories of learners in schools and in each classroom, whose dispositions toward education might also vary. It is therefore imperative to examine the use of multimedia technology to enhance learning outcomes for students with special educational needs.

Research Objectives

The following were the objectives of the study:

1. To examine the extent of use and incorporation of multimedia in special needs education
2. To examine the perceived benefits of using multimedia in special needs education
3. To identify the challenges of the use of multimedia in special needs education.

Literature Review

The Concept of Multimedia

The growing evolution in media technology has brought about what we called the multimedia into human communication system. As it is conceptualised by Ray and Benigno (2022), multimedia is an application that brings variations of elements such as graphics, audio and video together for the purpose of

presenting idea and at the same time making learning easier and faster. Multimedia, according to Iihan and Oruc (2016), in Turkish Language Society (TLS), is "the platform where a material is combined with text, graphs, audio, and simulation. This buttress the fact that multimedia involves the combination of media, which are integrated into a single package.

Raffat et al. (2015) defined it as the representation of multidimensional way of communication and Sousa (2017), cited Schnotz and Lowe (2003), stated that the term multimedia is the combination of multiple technical resources for the purpose of presenting information represented in multiple formats via multiple sensory modalities.

Breaking it down further, Ray and Benigno (2022) noted that the advancement of technology has resulted in increasing use of multimedia not only in all dimensions of communication process, but also particularly in teaching and learning. The use of multimedia in education offers several teaching methods, such as the usage of PowerPoint for presentation, documentaries creation, and movies production. The use and application of multimedia in these ways ensure the incorporation of text, graphics, audio, video, as a presentation involving audio and video clips would be considered a multimedia presentation (Ray and Benigno, 2022).

Multimedia in Education

A major challenge of learning process in most schools has been the lack of learning media, which in ideal situation when put to use, helps to overcome students staying less active and less interested in learning (Yudhie, Eka, Oding, & Layung 2022). In defining multimedia fitting into education use, Sousa (2017) expresses that multimedia is a technological package that helps teachers/lecturers to put text, graphics, animation, and other media into one package in order to achieve a comprehensive information presentation.

Yulyani, Arisanti, Fitria and Desyandri (2020) remarked that multimedia is greatly useful for enhancing self-study, providing an affective climate for learning where individual can gain meaning that is more affective and unforgettable. Thus, multimedia increases learning motivation; provides feedback and allows individual control - when it is being used Yulyani, Arisanti, Fitria and Desyandri (2020).

On a broader assessment, multimedia is one of the most complex and versatile digital learning media for creating knowledge and enabling a sensory learning environment, which, in turn, helps students to learn better by integrating

information (Olufunke, Harun & Zakaria, 2022). According to these scholars, the strength of multimedia is seen in its ability to emphasise on real-world experiences; thereby making learning adoptive and adaptive. Expatiating this further, learning, while having fun, is possible, distinctive and mostly in isolation from the media. This clearly implies that multimedia use for learning can create an authentic learning environment where attention is sustained (Tajeri, Syal, & Marzban, 2017) and learners find learning engaging, fascinating and fun- filled (Yang & Baldwin, 2020).

Chong (2019) opined that multimedia use in education has increased students' motivation and engagements, thereby resulting in increased assimilation of knowledge (Radianti, Majchrzak, Fromm & Wohlgenannt, 2020) and enhanced learners' academic attainment (Tajeri, Syal, & Marzban, 2017). Furthermore, multimedia does not only provide opportunities for students to construct their own knowledge (Fatirul, 2020), it also improved students learning outcomes (Lin, & Lin, 2019).

Multimedia Technologies for Learning

The advancement in computer speeds and storage space has made multimedia a commonplace today (Ray & Benigno 2022) such that its incorporation in learning has become highly popular. Raja and Kumar (2010) reinstated that the use of multimedia for teaching is strategic as it comprises more than one instructional technique for engaging teaching because different media are put to use during teaching and learning activities with students. These media include things which are strategically manipulated, things that can be seen, heard, read or spoken. Also, Xuan, Siti and Quan (2023) noted that digital tools, such as tablets, software applications, video and audio tools, interactive whiteboards, and online platforms, which are reflection to multimedia packages, are effective for educators' teaching delivery.

Therefore, multimedia technologies for learning include: Instructional Software, Enterprise Management Software and Student Information Systems, Global Positioning Systems, Classroom Administration, and Digital/Online Content, and Data Warehouses, Interactive Whiteboards and LCD Projectors, Sound Enhancement, Smart Cards, , and Digital cameras (Jastaniyah, 2017).

Overview of Different Types of Children's Disabilities and Special Needs

Khushaboo and Kavita (2022) considered children with special needs as those who have a disability in some areas and need special support and care. They further opined that the categorisation of these children's disabilities determines

their special needs. The categorisations include: physically disabled children, mentally disadvantaged children and socially maladjusted children. Similarly, children can suffer different arrays of impairment, and thus, there are visual impaired children, hearing impaired, children with impaired speech and mentally challenged children Khushaboo and Kavita, 2022).

Similarly, Malam and Malama (2021) noted that special needs categorisation result from disability, which on a broad assessment are consequence of an impairment that may be cognitive, physical, mental, sensory, emotional and developmental. Children with disabilities vary (Ringø & Emil, 2025) in respect to the type, number of disabilities, cause, degree, alongside the effect it has on the children education. Some children have specific deficiencies such as: reasoning, learning, spelling, calculating, reading, listening and writing difficulties. However, the main defining characteristic of these children is that for their learning difficulties, specialised education is mostly and importantly required in order to meet their needs (Jeneffer et al., 2022)

Therefore, there are various educational settings for children with special needs (Malam and Malama, 2021). Thus is to say that the necessity for a special needs school is the best option to attend to this distinctive disability of children. The school is expected to have capacity to cater for students who have special educational needs as a result of their physical disabilities, low cognitive development and behavioural problem (Peta, Lisa, Susan, Natalie & Aisha, 2023). Special schools are specifically structured and staffed with concern for special education for children with special needs (Khushaboo & Kavita, 2022). Such schools are special in their structure and process which are meant to cater for the needs of the children who have difficulties in acquiring academic skills such as reading, spelling, writing, speaking, understanding, listening, thinking or arithmetic (Jeneffer et al., 2022).

Multimedia Applications in Learning for Children with Special Needs

For children with special needs, the positive effects of technology have even been clearer and much more positive than for the general school-age population (Christodoulos, 2023). Peta, Lisa, Susan, Natalie and Aisha (2023) noted that children with special needs usually require additional assistance and care in opportunities for learning, communication, mobility, interpersonal interactions and relationship building. This explains why the use of technology is increasingly becoming a strategy for supporting young children with special needs.

Multimedia software and multimedia learning environments have been proven to be effective in helping children with disabilities to develop skills in domains as varied as academic domains of literacy and numeracy, life skills and social interaction (Sousa, Richter & Nel, 2017). Therefore, different multimedia applications can be used to enable t disabled learners adopt their own style of learning as human brain learns using many senses such as sight, hearing or touch (Raja & Kumar, 2010). Sousa, Richter & Nel (2017) added that lecture that integrates pictures or video images can help children with disabilities to learn and retain information much more effectively.

Since the cognition strength and ability of learners varies, multimedia element can enhance learning by any category of learners (Tajeri, Syal, & Marzban, 2017). This means that multimedia approach to teaching is a strategy that comprises more than one instructional technique for teaching. Thus, different multimedia applications can be used to present disabled learners with visual, auditory or kinesthetic experiences, thereby helping them to adopt their own style of learning. Such multimedia include: audio, visuals, such as videotapes, television, computers, motion pictures, and regalia, such as globes specimens, models, kits. There is also instructional media that are mainly projected, such as slides, transparencies, projectors, and those that non-projected media, such as chalkboards, bulletin / magnetic boards, photographs, pictures, charts. All these can benefit learners that are challenged in different ways because the multimedia can provide a variety in learning.

Tajeri, Syal, & Marzban (2017) also identified educational media namely print media to include books, programmed texts, flash cards, electronic media or the non-print media, which include CCTV, computers and other machines that help greatly in overcoming physically-challenged children' learning problems.

Christodoulos (2023) emphaisesd that students with physical disabilities learn more easily through the use of assistive technology such as the use of eyelid switches or other communication devices that replace speech. Also, students with learning difficulties are able to achieve cognitive access by using appropriate software on the PC, which enhances digital use of image or video with written text.

In the same vein, Israel et al.'s (2014) work on supporting content learning through technology for students with disabilities revealed that, in the past decades, two types of overlapping technologies have been most prevalent in supporting students with disabilities and other struggling learners: AT and IT (Assistive Technology and Instructional Technology) respectively. According

to them, these technologies have an array of functions, such as speech recognition software, which is highly beneficial for students with dysgraphia or dyslexia, and is routinely acknowledged as AT for students with disabilities. They also noted that this same technology is ubiquitous on current smartphones and other mobile devices that people without disabilities use on a daily basis.

Benefits/Effects of Multimedia Incorporation for Special Need Education

Due to the strength of multimedia in its ability to provide two or more media elements in a single compartment, it offers its users undeniable benefits. The different dimensions of the benefits of multimedia to special needs education have been confirmed by various scholars.

Mohamad and Saleem (2023), in their work, observed that the use of technology like multimedia helps greatly in learning. As learning using visual aids is expedient for children who have particular requirements, such as students with special needs who struggle with abstract cognition and retention capacity, the instructional tools or media can be tailored to accommodate these challenges.

Eka, Dwi and Yoga (2023) also examined the effectiveness of multimedia-based learning materials for deaf students in online learning and find out that hearing impairment experienced by deaf students has an impact on language and academic development. However, multimedia has been able to take into an account the theoretical and research bases of learning for people in this category of impairment. Therefore, interactive multimedia tools are confirmed to lead to a significant increase in reading skills among students with specific learning difficulties.

Also, Iyamuremye, Nsabayezu, Mbonyiryivuze and Mbonyubwabo (2023) discovered that the use of technological tool facilitates the process of mathematical exploration. Stressing that with these specialised approaches to teaching, most disabled learners can be helped to learn normally.

Joei & Noraffandy's (2022) study revealed that audiovisual context has progressed into a new approach that sharpens the analytical reasoning and rational social skills of special needs students. Their study proved that multimedia technology in learning can assist students with learning disabilities, as it could benefit autistic students, thereby demonstrating the educational potential of a multimedia system.

Challenges of Multimedia Use in Special Needs Education

Despite the wide arrays of benefit that multimedia offers in the area of special needs education, there are observable challenges as well. Prominent among the challenges is the fact that the development of multimedia resources for this special population is still limited as it is considered not commercially viable to develop the media for this market; and this has also hindered the integration of multimedia technology in special education classes (Jeneffer et al., 2022).

Also, it has been confirmed that the software is usually too difficult for children with learning disabilities while in classes (Jeneffer et al., 2022). Often, it is the special education teachers that interact with the software through demonstrations rather than the students engaging with the multimedia programmes themselves.

Khan (2010), however, argued differently. He observed that autism and Down's syndrome children cannot translate the use of multimedia into learning, but they do often have enjoyable moment when exposed to multimedia.

Theoretical Framework

Piaget theory **(**1936) proposed that children pass through cognitive development stages, which are basically four, the sensorimotor, preoperational, concrete operational and the formal operational stages. These four stages are initially being influenced by a schema- a basic building block that helps to form a mental representation of the world (McLeod 2018, cited Piaget 1952). This is a way of organising knowledge that leads to a process of adaptation consisting of assimilation and accommodation.

For intellectual growth, the point of assimilation is when the existing schema is dealing with a new situation. Whereas, accommodation comes when the existing schema does not work and needs to be changed in order to deal with a new object or situation (McLeod, 2018).

Viewing special needs children in the light of Piaget's theory of cognitive development, it can averred that there is an existing building block of knowledge around such children, too- only that they need to be introduced to this block of knowledge in a different situation.

Paul (2016) thereby stipulated that multimedia approach of instruction (audio, video, graphics, internet, animations etc.) is essential for effective and efficient learning because in any learning situation, the more the senses are

stimulated, the more the person learns and the longer he retains what he learns. Buttressing this assertion, Paul (2016) added that multimedia , including Power Point presentations, can be used to encourage students to work in groups, express their knowledge in multiple ways, solve problems, revise their own work, and construct knowledge.

Methodology

The research design for this study was qualitative with a case study method, using learners with special needs. This group was singled out with the aim of assessing the benefit of incorporating multimedia on their education. Therefore, the implementation of this design and method was in line with the research objectives of ascertaining the use of multimedia and exploring the benefits and challenges of its use in special needs education.

Kwara State School of Special needs was used as the case study. An in-depth interview was conducted with five (5) educators/ instructors. Using five interviewees is supported and approved as acceptable by Creswell (2012) who recommended a sample size of at least 5 to 25 participants. Using the few participants also became necessary because of the unwillingness of most educators to grant the interview. Purposive and snowball sampling approach was used to get the five participants that eventually gave their consent to participate in the study. The interview was conducted for the participants mostly via WhatsApp where the interview questions were shared and answered. Data were analysed through the thematic analysis approach that enabled a robust process of identifying the reoccurring patterns, themes and insights from the data.

Data Analysis

Table 1, 2, and 3 and Figure 1, 2, 3 indicate all the main themes and sub-themes which answered each of the research questions.

RQ1: To examine the extent of use and incorporation of multimedia in special needs education
Table 1: Use of Multimedia in Special Needs Education

Themes	Sub-themes	Key Insight
1. Accessibility and incorporation	Incorporation of multimedia equipment	equipment such as projectors, computers, and video displays are introduced; but usage is not consistent
2. Barriers to effective incorporation	Lack of teacher training	Most educators lack the training needed for effective use of multimedia.
	Infrastructure challenges	Poor electricity supply and faulty solar systems hinder incorporation

Source: Developed from the study's data

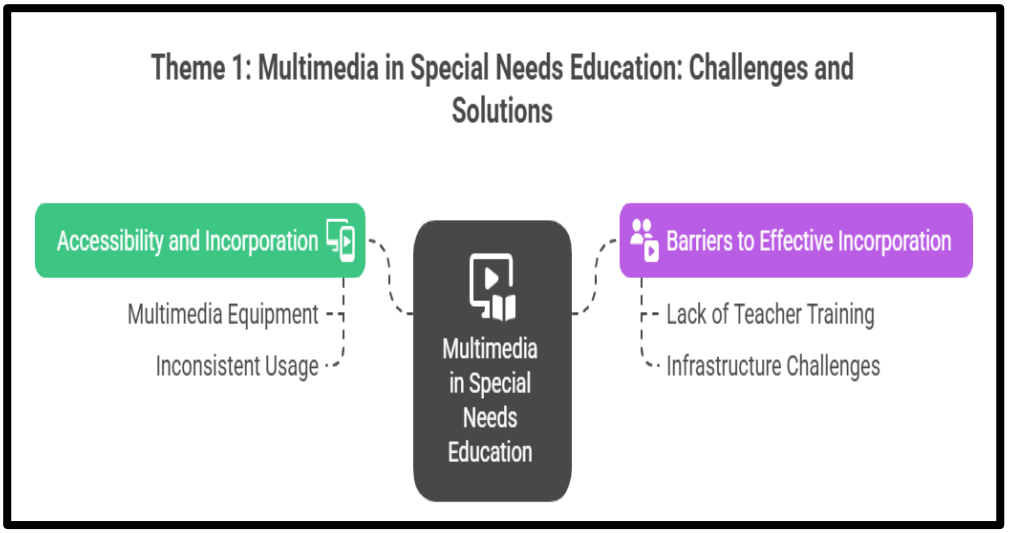
Theme One: Accessibility and Incorporation

Sub- theme: Incorporation of Multimedia Equipment

All the five Informants indicated that multimedia had already been introduced in their school, although their reflection on it was indicated in different extent. Informant 1 indicated "the use of laptops, projectors and learning videos to aid learning for children with disabilities". Informant 2 revealed "the use of gadgets, such as computerised systems, televisions with video display systems, and interactive materials for rhymes and for recognition of objects". However, Informants 3, 4 and 5 simply stated that basic computer systems were available with Informant 4 indicating that they were not available to learners and Informant 5 indicating that there were no ICT trained teachers and that power problems often disrupted the process of using the multimedia equipment for teaching and learning .

This finding implies a moderately high level of incorporation of multimedia technologies in the special needs education in the school used as the case study. Although the tools were available, knowledge on how best to handle the infrastructure were constraints to their utilitisation. This aligns with the perspective of Al-Azawei et al. (2022) as they noted that availability is not the single factor impacting the successful integration of multimedia in education, but it is strategic inclusion, such as the competence of the teachers and access by the learners. Moreover, Adebayo and Omolayo (2021) noted that the

availability of educational tools should never be confused with their proper usage unless there is proper pedagogy training and curriculum adjustment. And this is a factor that was unanimously and clearly presented in the majority of the participants' responses.



Theme Two: Barriers to Effective Incorporation

Sub- theme 1: Lack of Teacher Training

Informants 4 and 5 specifically noted that most teachers have little or no training on the use of multimedia equipment, and this is a serious constraint in classroom learning. Abdullahi and Ajayi (2023) similarly emphasised the importance of the digital competence of teachers in the context of enhanced learning outcomes in special education. This implies that the application of multimedia tools in the absence of training only makes it under-used or misused, and at the end, learners with disabilities are less attended to.

Sub- theme 2: Infrastructural Challenges

Others issues cited by the informants are poor electricity and solar back-ups, which are not functional, and, which, in turn, affect the effective use of multimedia. According to Nwachukwu and Obielodan (2021), unstable power supply and insufficient ICT infrastructure are greatest obstacles to digital tools usage in schools in Nigeria. They added that, such infrastructural issues, as confirmed by the informants in this study, pose greater challenges on special education units.

RQ2: To examine the perceived benefits of using multimedia in special needs education

Table 2: Perceived Benefits of using Multimedia in Special needs Education

Themes	Sub-themes	Key insight
Increased Engagement	Enhance attention and focus	Multimedia keeps learners focused and reduces distractions through visual appeal like cartoons, videos, and real-world representations
	Active and keen participation	Multimedia encourages interaction, expression of ideas, and smooth teacher-learner relationships.
Improved Comprehension	Visual learning for better understanding	Learners comprehend better using images, visual aids, and demonstrations—especially beneficial for hearing-impaired or developmentally delayed students.

Source: Developed from the study's data

Theme one: Increased Engagement and Classroom Participation

Sub- theme 1: Enhance Students' Attention and Focus

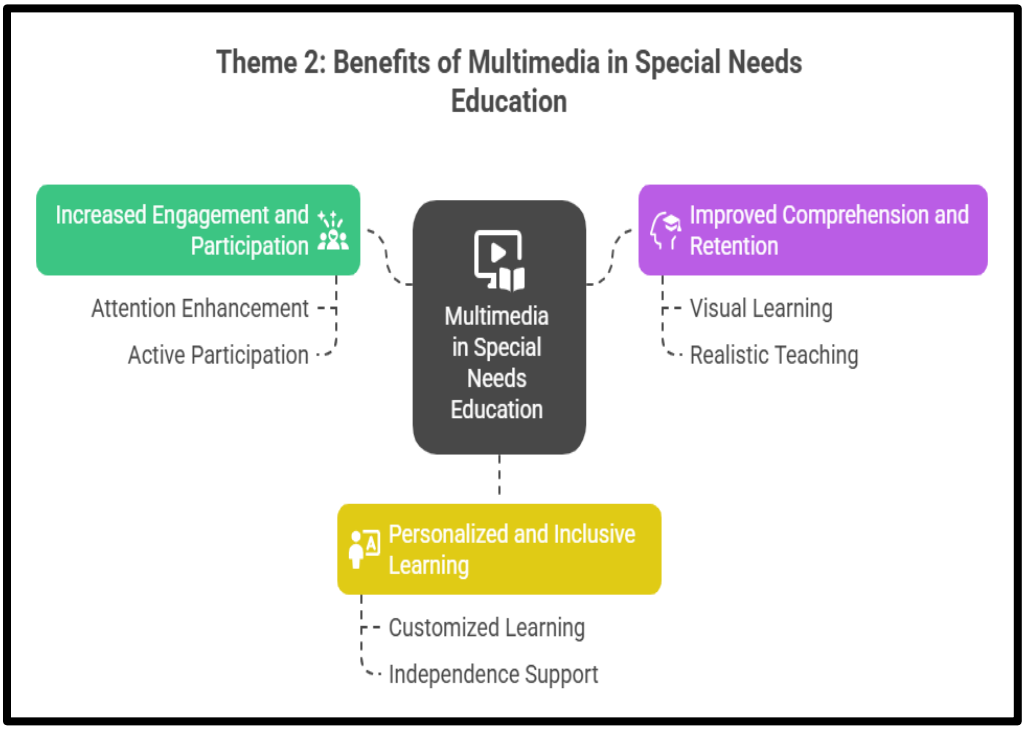
According to Informant 5, televised contents draw learner attention and make them eager to remain in the class. Informant 4 also noted that multimedia keeps the learners at the edge of their seats and thus minimises distraction. This outlines multimedia strength in keeping the learner focused particularly during learning; and, thus, children with attention deficiency ADHD or autism are well catered for. This justifies Alqahtani et al.'s (2021) opinion on

multimedia use in the classrooms as having ability to enhance visual and audio stimuli, thereby reducing distractibility in the classroom and encourage the students with cognitive and sensory discrepancies to stay focused for a longer period.

Sub- theme 2: Active and Keen Participation

Informant 2 said that "multimedia helps students to express opinions, which means that the process of learning gets more interactive and democratic". Informant 4 also noted that "multimedia enhances cordial interaction among teachers and learners." This is in concordance with Hassanzadeh & Jafarigohar (2020) who discovered that learning atmospheres supported by multimedia can transform passive participants into active participants particularly in inclusive environments where learners require different level of support.

Theme two: Improved Comprehension and Retention



Sub- theme 1: Visual Learning for Better Understanding

Informant 1 noted that pictures and videos help greatly to improve understanding. Informant 3 stressed that the children with hearing impairment remember what they see more than what they hear. Informant 5 said that visual aid illustrating math lessons enhances comprehension. According to this informant, multimedia also serves visual learners, as it is helpful especially in special education where students might be auditorily impaired or cognitively impaired. Adu-Gyamfi & Ofori-Ampong (2022) confirmed this finding by noting that visuals, simulations, and animations develop mental models to facilitate long term memorisation of an abstract or complex issue**.**

Sub- theme 2: Realistic and Simplified Teaching

Informant 3 revealed that "multimedia tools like graphical images and videos can make teaching process easy, when real thing or procedure is presented. Informant 4 also said that it simplifies and makes teaching a reality. Experiential learning can be done using multimedia tools where abstract concepts can be visualized, using real-life simulations or through dramatised real-life content". Al-Azawei et al. (2022) stated that not only does the multimedia enhance conceptual clarity and critical thinking, it also contributes to improving special needs learners who receive multisensory inputs.

Theme three: Personalised and Inclusive Learning

Sub- theme 1: Customised Learning Experiences

It was noted by Informant 1 that "with multimedia, individualised learning is facilitated and independence can be increased. Multimedia can help learners to learn at their own pace and access their preferred formats (text/video/audio) and replay on matters that they want. Abdullahi & Ajayi (2023) established in this wise that since learners with disabilities are empowered, personalised digital content ensures students with disabilities have independence, and independence is supported through autonomy and an adaptive feedback loop.

RQ3: To identify the challenges of the use of multimedia in special needs education

Table 3: Challenges of Using Multimedia in Special Needs Education

Themes	Sub-themes	Key Insight
Infrastructural	Poor electricity	Multimedia tools are under-utilised due to inconsistent power and faulty solar

Barriers	supply	alternatives.
	Lack of devices and technical resources	Schools lack adequate gadgets, funding, and maintenance support.
Human and Policy Constraints	Insufficient teacher training	Many educators are not skilled in multimedia or ICT integration.
	Restrictive device use Policies	Bans on student phone usage limit access to interactive tools like Kahoot or mobile apps that aid special education.
	Lack of specialised content	There is limited availability of multimedia content specifically designed for students with special needs.
Adaptive Strategies	Peer and one-on-one support	Teachers use peer tutoring and individualised support to help learners adjust to multimedia tools.
	Foundational ICT training for students	Basic computer literacy and exam preparation skills are taught to students to improve digital fluency and reduce anxiety around tech usage

Source: Developed from the study's data

Theme one: Infrastructural and technical barriers

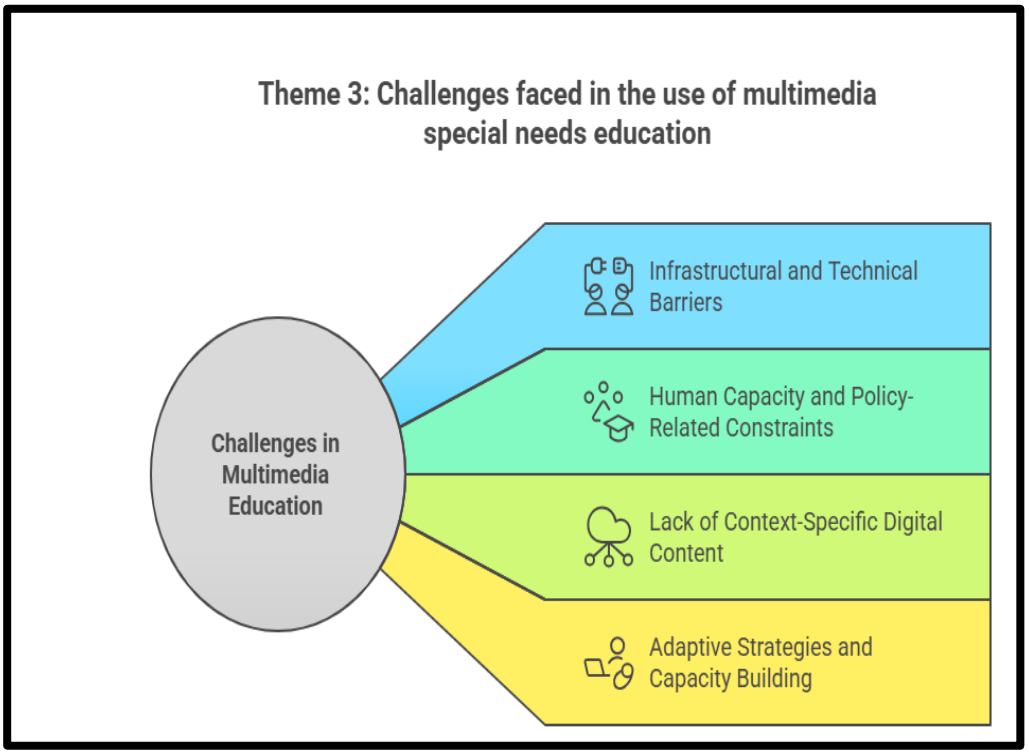
Sub- theme 1: Poor and Stable Electricity

Informants 2 and 3 cited electricity as a major constraint to the use of multimedia tools. Informant 2 called it "the poor/unstable electricity", and

Informant 3 noted "it as one of the greatest constraints. Operation of digital tools requires steady power supply". This is why Nwachukwu & Obielodan (2021) confirmed that infrastructural constraints, particularly the lack of consistent electricity, are one of the greatest obstacles to the integration of ICT in Nigerian schools.

Sub- theme 2: Lack of Devices and Technical Resources

The second Informant identified the lack of multimedia equipment, financial mismanagement, and skill deficiencies in the technical field as the major constraints to the use and incorporation of multimedia technologies in the special needs school . The unavailability of applications and gadgets was also identified as a constraint by Informant 3. Adu-Gyamfi & Ofori-Ampong (2022) similarly claimed that teachers cannot provide custom learning to tudents due to the inability to access the correct assistive technologies. This shortage is indicative of poor financing and poor systemic execution of inclusive education programme in developing countries.



Theme two: Human Capacity and Policy-related Constraints

Sub- theme 1: Insufficient Teacher Training

Informants 1, 2, and 4 identified the absence of trained staff and technical expertise as obstacles to efficient multimedia usage. In this wise, Abdullahi & Ajayi (2023) stated that most special education teachers do not receive training about applying multimedia tools in the learning process. Even those technologies which are available are not properly applied or utilised.

Sub- theme 2: Restrictive Policies on Device Use

Informants 4 and 5 complained that some policies forbid learners to use a phone, even though the use of phone might help in making educational activities easier and interesting. The use of some apps such as Kahoot has been confirmed to enhancing learning process and outcomes. Low-cost assistive technologies and mobile phones are becoming a widely used low-cost assistive technology in special education. Thus, Al-Azawei et al. (2022) cautioned that, even though mobile learning tools have the potential to facilitate self-paced and gamified learning, the integration of those tools into the classroom environment is obstructed by restrictive institutional policies.

Sub- theme 3: Lack of context-specific Digital Content

Informant 1 noted there was limited access to specialised contents, which could be tailored to the needs of special learners. The absence of localised, disability-specific educational media reduces the effectiveness of the available platforms. This is why Edeh and Iloh (2023) advocated for developing culturally and contextually relevant digital contents to engage students more effectively with diverse needs.

Theme three: Adaptive Strategies and Capacity Building

Informant 1 offered one-on-one guidance or peer support to students struggling with multimedia tools. Informant 2 said he provided training in basic digital skills such as typing and document management and helped students prepare for Computer-based Tests (CBT). These strategies reflect low-tech, teacher-led approaches to bridging the digital gap. Kebritchi et al. (2020) recommended similar scaffolding strategies in low-resource settings, where direct instruction and peer collaboration can supplement the lack of advanced infrastructure.

Conclusion and Recommendations

This study has examined the incorporation and use of multimedia in special needs. The highlight of the outcome of the examination is that multimedia has a way of catering for learners with varying special needs. Nevertheless, the incorporation and use of multimedia in special needs education is being militated by some major challenges. In the light of this, the following recommendations are presented for implementation:

1. Government and private individuals should collaborate and pool resources for ensuring availability and accessibility of multimedia in special needs education.
2. Adequate funds should be made available for effective and efficient running of schools of special needs, and especially for the procurement and maintenance of essential infrastructure that can enhance learning outcomes for learners with special needs.
3. Future research on the incorporation and use of multimedia should focus on distinctive categories of special needs children that are different from the ones used as a case in this study.

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CHAPTER THREE

Cross-Cultural AI Education: Internationalising Curriculum for Equitable Global Impact

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Abstract

This study addressed global disparities in AI education through curriculum internationalisation. Analysing AI educational frameworks across 12 countries on six continents, we identified key barriers: algorithmic colonialism, culturally homogeneous training data, English-language dominance, and context-insensitive pedagogies. The study proposed the Culturally Responsive AI Education (CRAE) framework featuring three dimensions: pluralistic epistemological foundations integrating diverse knowledge traditions, localised dataset development, reflecting regional priorities, and multilingual programming environments, reducing linguistic barriers. Our 30-month mixed-methods study examined curriculum documents from 38 institutions, conducted 54 faculty interviews, and analysed instructional materials, using comparative methods. Implementation across universities in Nigeria, Brazil, India, and Germany showed enhanced student engagement and technical mastery through connecting AI concepts to locally meaningful problems. Results indicated that the CRAE framework facilitates genuine knowledge exchange between Western and Global South institutions and has the potential to reshape the global AI development landscape to address diverse regional priorities. This research contributed to advancing educational practices that can help democratise AI innovation while preparing students to work effectively across cultural boundaries in an increasingly interconnected technological landscape. By fundamentally reconsidering how AI is taught and applied across diverse cultural contexts, this study contributed to a more equitable distribution of AI benefits globally.

Keywords: Internationalization, Curriculum, Artificial Intelligence Education, Cross-cultural Education.

Introduction

Artificial intelligence (AI) technologies are rapidly transforming societies worldwide, yet the global distribution of AI research, development, and educational capacity remains profoundly unequal (Acemoglu, 2021). While academic institutions across diverse regions increasingly offer AI education, AI education's curricula often unconsciously replicate Western epistemological frameworks, technical priorities, and pedagogical approaches (Mohamed et al., 2020). The result is a concerning homogenisation of AI education that potentially limits innovation diversity and reproduces existing power imbalances in global technology development (Birhane & Guest, 2021).

Integrating an international, intercultural, or global dimension into the purpose, functions or delivery of postsecondary education through the internationalisation process of the curriculum (Knight, 2015) presents a promising pathway to address these inequities. However, the unique challenges of internationalising AI education remain underexplored in both educational research and practice. This study addressed this gap by examining how AI curriculum could be meaningfully internationalised to promote more equitable global participation in AI development.

The research was motivated by three interrelated questions:

What are the primary barriers to effective internationalisation of AI curriculum across diverse global contexts?

1. How can AI education be restructured to incorporate diverse cultural perspectives, knowledge traditions, and regional priorities?
2. What impact does internationalised AI curriculum have on student learning outcomes and the development of culturally responsive AI applications?

Drawing on a comparative analysis of AI educational frameworks across 12 countries and an implementation study spanning four international university partnerships, the study proposed a novel framework for Culturally Responsive AI Education (CRAE). This framework offers both theoretical grounding and practical strategies for internationalising AI curriculum in ways that enhance educational outcomes while potentially reshaping global AI development trajectories.

Literature Review

Significant disparities in global AI research, development, and education have been extensively documented by different researchers. A bibliometric study by Mou (2022) found that just five countries, namely the United States, China, the United Kingdom, Germany, and Canada, produce nearly 72% of peer-reviewed AI research publications. These disparities are mirrored in educational capacity, with Agarwal *et al*., (2021) documenting that high-quality AI educational resources remain concentrated in wealthy nations and are frequently inaccessible to students in low-resource settings due to language barriers, prohibitive costs, and infrastructure limitations.

These educational inequities have profound implications for the global AI landscape. As Wang and Deng (2021) argued that "The geographic and demographic composition of the AI research community directly shapes which problems are prioritised, which datasets are constructed, and ultimately, which populations benefit from AI advances". When AI education is concentrated in a small subset of global contexts, it tends to reproduce technologies that best serve those same contexts (West *et al*., 2019).

While internationalisation has received significant attention in higher education broadly (Knight, 2015; Leask, 2015), computer science and AI education present unique challenges. Clear *et al*., (2017) identified several discipline-specific barriers to internationalisation in computing education, including the perception of computer science as culturally neutral, the dominance of English in programming languages and documentation, and the emphasis on technical skills over cultural competencies.

Despite these challenges, several promising approaches to internationalising computing education have emerged. Cross-national collaborative programming projects (Matthiasdottir & Falakmasir, 2018), integration of indigenous knowledge systems into computing pedagogy (Bidwell, 2016), and critical technical practice approaches that situate technology development within cultural contexts (DiSalvo, 2022) have all demonstrated potential for more culturally responsive computing education.

A growing body of research highlights the cultural embeddedness of AI systems. Sambasivan *et al*. (2021) document how AI technologies developed in Western contexts often fail when deployed in the Global South due to divergent infrastructural assumptions, cultural norms, and user needs.

Similarly, Birhane (2021) argued that the epistemological foundations of machine learning, including assumptions about objectivity, universality, and progress, are deeply rooted in Western philosophical traditions that may not align with other knowledge systems.

These cultural dimensions extend to AI education as well. Raji et al. (2021) analysed AI ethics curricula, finding that they predominantly centre Western philosophical frameworks while marginalising non-Western ethical traditions. Alenuma-Nimoh (2016) observed that AI educational materials frequently use examples, applications, and datasets that reflect the experiences and priorities of dominant cultural groups, potentially alienating students from underrepresented backgrounds.

While these bodies of literature offer valuable insights, significant gaps remain in understanding how to effectively internationalise AI curriculum. First, most studies of internationalization in computer science education have not addressed the specific challenges of AI education, which involves not only technical programming, but also statistical modelling, data practices, and considerations of societal impact. Second, while research has documented cultural biases in AI systems and educational materials, it has provided limited guidance on practical strategies for developing culturally responsive AI curriculum. Finally, empirical studies examining the implementation and impact of internationalized AI curriculum remain scarce, particularly those spanning multiple global contexts.

This study addressed these gaps by developing and testing a comprehensive framework for Culturally Responsive AI Education that is empirically grounded in diverse global contexts.

Methodology

This study employed a sequential mixed-methods design conducted over a 30-month period (2021-2023) to conduct a comparative analysis of existing AI educational frameworks across 12 countries. It analysed AI undergraduate and graduate curriculum frameworks from 12 countries across six continents: Nigeria, Kenya, Brazil, Chile, India, Indonesia, Germany, France, United States, Canada, Australia, and Japan. For each country, the study examined curriculum documents from 2-4 leading institutions offering AI degrees or specialisations with strong AI components (n=38 institutions total).

Data collection included:

- Analysis of official curriculum documents, course syllabi, and programme descriptions;
- Semi-structured interviews with faculty members responsible for AI curriculum development (n=54); and
- Thematic analysis of instructional materials, including textbooks, assignment descriptions, and assessment tools.

Data analysis employed a constant comparative method (Glaser & Strauss, 1967) to identify common patterns and divergences across educational contexts. We focused particularly on four dimensions of AI curriculum: (1) epistemological foundations and assumptions; (2) technical

content and skill priorities; (3) dataset selection and development practices; and (4) pedagogical approaches and assessment methods.

Findings: Barriers to Internationalization of AI Curriculum

The comparative analysis in this study identified four key barriers to effective internationalisation of AI curriculum across global contexts:

Algorithmic Colonialism in Educational Frameworks

Across institutions in the Global South, we observed what can be described as "algorithmic colonialism" in AI curriculum design. This manifested as uncritical adoption of curriculum structures, technical priorities, and pedagogical approaches developed in Western (particularly U.S.) contexts, often without adaptation to local needs, resources, or cultural contexts.

Culturally Homogeneous Training Data and Examples

Analysis of instructional materials revealed a striking homogeneity in the datasets, examples, and applications used in AI education globally. Across all 12 countries, we found heavy reliance on standard benchmark datasets developed primarily in North American and European contexts (e.g., ImageNet, MNIST, Wikipedia-derived text corpora, WEKA, etc). These datasets frequently embed Western cultural assumptions and priorities, limiting students' exposure to diverse data contexts. Even when discussing AI applications, case studies predominantly featured examples from Western contexts. Many examples are about "All our examples are about optimising

ride-sharing in San Francisco or detecting credit card fraud in New York. There were hardly discussions or examples of applications relevant to the country's context. This makes AI feel imported rather than something that the students can shape. This homogeneity reinforces the perception of AI as a culturally neutral technology rather than one that should be responsive to diverse contexts.

English-Language Dominance

Despite the global distribution of AI research and education, English remains overwhelmingly dominant in AI curriculum. Our analysis revealed three dimensions to this dominance:

1. **Programming interfaces:** Most AI libraries and frameworks use English-based syntax and documentation, creating additional cognitive load for non-native English speakers.
2. **Educational resources:** High-quality AI educational materials remain predominantly available in English, with translations often delayed or unavailable even for a bi-lingual country like Canada.
3. **Technical vocabulary:** The specialised terminology of AI has limited equivalents in many languages, forcing students to learn concepts through linguistic frameworks that may not align with their native conceptual structures.

Thus, while students are expected to simultaneously learn complex mathematical concepts, programming syntax, and English technical vocabulary; for some, the linguistic challenge may overshadow the technical content, creating artificial barriers to mastery.

Context-Insensitive Pedagogical Approaches

Our analysis revealed limited adaptation of pedagogical approaches to diverse cultural learning traditions and educational contexts. Across institutions globally, AI education predominantly employs pedagogical models developed for Western educational settings, including:

- Heavy reliance on independent project work rather than collaborative learning;
- Emphasis on competitive achievement (e.g., leaderboards, competitive challenges) over cooperative problem-solving; and

- Assessment methods focusing on individual technical mastery rather than contextual application or social impact.

These approaches often conflicted with local educational traditions and student learning preferences. In Nigeria for example, where students come from cultural backgrounds that emphasise collaboration, an AI curriculum that impose highly individualistic and decontextualized learning models from Western AI education will make many of the students struggle not because of the technical content but because of the cultural mismatch in how they are expected to learn.

The CRAE Framework: Principles and Implementation

Based on our comparative analysis, we developed the Culturally Responsive AI Education (CRAE) framework to address the identified barriers to internationalisation through three interrelated dimensions:

Pluralistic Epistemological Foundations

The CRAE framework integrates diverse knowledge traditions and epistemological approaches into AI education, challenging the assumed universality of Western technical frameworks. Key implementation strategies include:

Comparative Epistemological Analysis

Courses incorporate explicit comparison of how different cultural traditions conceptualise intelligence, learning, and the relationship between humans and technology. For example, a course module developed at the Thomas Adewumi University, Nigeria, paired Western computational perspectives on AI with Yoruba epistemological frameworks, examining how different conceptualisations of intelligence shape technical approaches to machine learning.

Integration of Indigenous Knowledge Systems

Curriculum incorporates indigenous knowledge systems as valid frameworks for approaching AI challenges. For example, an Australian-African universities' partnership can host AI courses that integrate Aboriginal and African approaches to classification and pattern recognition alongside conventional machine learning taxonomies, providing students with multiple conceptual frameworks for understanding key AI tasks.

Critical Technical Practice

Students engage in critical technical practice that questions the cultural assumptions embedded in AI systems. This approach will extend beyond conventional "AI ethics" by encouraging students to identify and challenge the cultural values embedded in technical choices throughout the AI development process. For example, understanding different cultural approaches to categorisation may completely change how the students will approach classification algorithms, such that 'technical' choices in feature selection and boundary definition will carry cultural assumptions they hadn't recognised.

Localised Dataset Development Practices

The CRAE framework emphasises the development and use of locally relevant datasets that reflect diverse cultural contexts and regional priorities. Implementation strategies include:

Local Dataset Curation Projects

Students will engage in collaborative projects to develop AI datasets representing local contexts, languages, and challenges. These projects will serve dual purposes: providing culturally relevant learning materials and contributing to the diversification of available AI training resources.

Comparative Dataset Analysis

When curriculum incorporates critical analysis of how dataset choices shape AI systems' performance across cultural contexts, students can examine how standard benchmark datasets embed cultural assumptions and how these assumptions affect model performance in diverse settings. For example, during implementations, students across geographies can collaboratively analyse performance disparities when applying standard image recognition models to photographs from different global regions, then develop techniques to address these disparities.

Context-Cantered Problem Definition

Rather than adopting standardised problem definitions from established benchmarks, course implemented in CRAE encourage students to define AI challenges based on local priorities and contexts. This approach shifts from a technology-cantered to a context-cantered perspective on AI education.

Having students identify AI applications relevant to their communities will completely transform engagement and motivate students who are previously struggling with abstract technical concepts as they will be applying those same concepts to locally meaningful problems.

Multilingual Programming Environments

To address English-language dominance, the CRAE framework incorporates strategies to reduce linguistic barriers in AI education:

The CRAE framework will support the development of programming interfaces that support multiple languages. While maintaining compatibility with English-based libraries (e.g., TensorFlow, PyTorch), these interfaces will allow students to use function names, documentation, and error messages in their primary languages, reducing cognitive load.

The CRAE framework is also engineered to support the development of glossaries mapping AI technical vocabulary across languages, not through direct translation but through conceptual equivalence. These resources will help students connect AI concepts to existing knowledge frameworks in their primary languages.

Besides, CRAE will ensure courses employ collaborative development environments supporting code annotation and documentation in multiple languages. This approach will allow students to programme in standard syntax while documenting and explaining code in their primary languages, separating linguistic knowledge from technical mastery.

Discussion: Implications for Global AI Education

The CRAE framework challenges dominant models of international education that position Western institutions as knowledge producers and Global South institutions as knowledge consumers. By recognising the value of diverse epistemological traditions and technical approaches, the framework facilitates genuine knowledge exchange that enhances AI education across all participating institutions.

This bidirectional knowledge flow has particular significance for AI, where computational approaches to intelligence have been overwhelmingly shaped by Western philosophical traditions. Incorporating diverse conceptualisations of intelligence and learning can expand the field's foundational frameworks,

potentially leading to novel technical approaches and applications.

Students in CRAE-implementing programmes are expected to demonstrate enhanced technical mastery precisely because of, not despite, the curriculum's cultural responsiveness. By connecting AI concepts to locally meaningful problems and culturally familiar frameworks, the approach reduces cognitive barriers and increases motivation, ultimately improving technical learning outcomes.

Perhaps most significantly, internationalising AI curriculum can help reshape the global AI development landscape. By preparing diverse students to develop AI applications addressing local priorities, using culturally appropriate approaches, educational institutions can contribute to a more equitable distribution of AI benefits globally.

Conclusion

As artificial intelligence increasingly shapes global societies, ensuring equitable participation in AI education and development becomes an ethical imperative. This study demonstrated that effective internationalisation of AI curriculum requires moving beyond superficial inclusion of global perspectives toward fundamental reconsideration of how AI is taught, learned, and applied across diverse cultural contexts. The Culturally Responsive AI Education framework offers a promising approach to this challenge, integrating pluralistic epistemological foundations, localised dataset development practices, and multilingual programming environments to enhance AI education globally. By addressing key barriers to internationalization, including algorithmic colonialism, culturally homogeneous training data, English-language dominance, and context-insensitive pedagogical approaches, CRAE principles can help democratise AI education and development. As AI technologies continue to transform societies worldwide, educational institutions have a critical responsibility to prepare diverse students to shape these technologies in culturally responsive and contextually appropriate ways. By reimagining AI education through international and intercultural lenses, we can help ensure that the benefits of AI innovation are shared equitably across our interconnected global community.

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CHAPTER FOUR

Attitude towards Knowledge Sharing among Library and Information Science Educators in Universities in South-west, Nigeria

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Abstract

The study investigated library and information science educators' attitudes towards knowledge sharing in Nigeria's South-West universities. The study adopted a survey research design, with a questionnaire serving as the data-gathering instrument. The study's population consisted of 480 Library and Information Science (LIS) educators working at universities in South-West Nigeria. The total enumeration of the population was used for the investigation. The data collection instrument was a questionnaire, with 334 copies found usable with a response rate of 69.5%. Data analysis was done through descriptive statistics. The findings demonstrated a positive attitude towards knowledge sharing among LIS educators. According to the findings, university administrators in South-West Nigeria should develop knowledge-sharing policies for LIS instructors.

Keywords: Attitude**,** Knowledge Sharing, LIS Educators, Practices, South-west.

Introduction

Knowledge sharing has evolved into a practice and culture that is actively employed to facilitate learning and achievement around the world. As a result, fostering a knowledge-sharing culture among teachers is critical for increasing cooperation, innovation, and continual professional growth, all of which benefit both students and instructors. Knowledge sharing is the process of exchanging information among individuals or groups of people with the goal of sharing ideas and gaining collaborative learning and experience in specific topic areas of interest to the users of the information. Educators' information sharing is a primary motivator for developing novel pedagogical approaches,

participatory learning, professional development, and enhanced curriculum design (Paiva & Quintas-Mendes, 2024; Yu, 2023; Wu, 2024; Meguro, 2024). Teachers foster a culture of innovation and pedagogical experimentation by sharing their experiences, resources, and best practices. Educators can benefit from each other's experience and know-how by sharing knowledge, and they are urged to use best practices while resolving instructional issues. However, attitude continues to be an important influence on behaviours and choices in a variety of areas of life, including schooling.

Educators' attitudes towards knowledge sharing are critical components in fostering a collaborative learning culture. Tanveer (2024) demonstrated how teachers' attitudes towards knowledge sharing encourage information sharing behaviour by allowing them to collaborate in fixing difficulties that arise in their profession. Attitude can be defined as a psychological tendency exhibited by judging a given entity with some degree of favour or disfavour. However, an unfavourable attitude towards an action or thought would be classified as negative. Positive attitudes can promote professional development, creativity, and innovation in educational institutions. It is, therefore, so critical to determine LIS educators' attitudes towards knowledge-sharing activities.

Attitudes can be cognitive, emotive, or behavioural in nature. The cognitive aspect refers to educators' attitudes about knowledge. For example, some educators feel that knowledge sharing leads to better teaching practices. The affective aspect frequently considers the feelings and emotions linked with the action, such as being excited about sharing knowledge with co-workers. However, in terms of behaviour, attitude refers to a predisposition to perform in a specific way. A favourable attitude towards information sharing may motivate an instructor to actively participate in joint projects. However, other circumstances influence the decision to share knowledge. Tella (2024) investigated further the drivers of teachers' desire to share knowledge and discovers that a healthy work environment and individual input recognition have a determining influence on educators' attitudes towards sharing knowledge. Wajid (2024) also looked into how people's feelings about the learning environment affect how they share information in the education sector. The results showed that teachers are more likely to be willing to share what they know and learn from others when they feel valued and supported.

The results show how important it is to have a positive attitude that makes teachers want to share what they know, which can help students learn better.

It is very important for LIS educators to share what they know with each other in order to improve their teaching methods, help their students do better, and make the classroom a place where everyone works together to learn. The practice involves sharing ideas, experiences, and resources, which can lead to new ways of teaching and making new curricula. According to Nya-Lin Yan (2016), knowledge sharing is when teachers are willing to build close relationships with their co-workers, which leads to sharing knowledge through teaching, research, and service. People share knowledge through writing, talking, and using technology. Writing, talking, and technology help in spreading knowledge. LIS teachers are also called "knowledge workers" because they are always creating, using, sharing, and applying knowledge. LIS teachers share what they know in many ways, such as through mentoring, working together, giving talks and presentations, holding seminars, having conversations, and getting together. They also share information through writing, such as newsletters, press releases, media advisories, book chapters, and books.

Knowledge sharing is critical in education because it allows LIS educators to successfully respond to changing educational trends. Several studies, like those by Xu and Li (2022), Adu and Olowu (2022), and Park et al. (2024), emphasised the relevance of information sharing in education. Park et al. (2024) discovered that instructors from diverse nations collaborated to sustain the quality of learning amid pandemic attacks such as COVID-19. Sharing knowledge would have been a difficult undertaking if not for technology innovation, which has enabled collaboration with co-workers from all over the globe. A variety of tools (e.g., ICT tools, social networking tools, the internet, and e-learning tools) are used to facilitate knowledge exchange, particularly in this digital age. Technology promotes knowledge exchange through internet platforms such as social media, emails, websites, forums, and Wikis. Elenurm (2024) investigated the use of social media as a medium to facilitate sharing of knowledge in optimal teaching methods in both virtual and face-to-face settings among academics.

Additionally, it is vital to determine what motivates teachers to share knowledge. Giving teachers incentives to share information can change their

attitudes a lot, making the workplace more open and collaborative. Incentives work as motivators, making teachers more likely to share what they know and have. There are many reasons why a teacher may choose to or not to share what they know. It could be about money, the state of the economy, the desire for recognition, or the level of support they get from their institution. All these factors can directly influence how they feel about sharing information. Wu (2024), for example, found that salary and material rewards can encourage teachers to share professional knowledge and experiences, which in turn leads to more collaboration and better sharing of resources among colleagues. In the same vein, Hosen et al. (2022) stressed that organisational support, especially through incentives, plays a huge role in defining teachers' attitudes towards knowledge sharing. Their study points out the need to create a safe and supportive environment, where teachers feel valued for what they contribute. One clear way to shift attitudes in a positive direction is by offering financial incentives. As Zaremohzzabieh and Mohd Rasdi (2025) pointed out, understanding what drives people to share knowledge makes it easier to tackle the barriers and strengthen the motivators. If institutions reward their teachers for sharing, it could open the door to a stronger culture of collaboration and better teaching practices across the board.

According to research, people see their knowledge as a source of power (Kundi et al., 2023). So, giving up this knowledge may make LIS trainers feel like they are giving up the secrets to their job security, and thus they are likely to be reluctant in sharing what they know (He et al., 2023). This would discourage knowledge sharing in the education industry because instructors who believed they could be rendered redundant would not share their expertise. As a result, people's unwillingness to share knowledge is a problem that must be addressed. For example, incentives should be provided to encourage educators to share their knowledge. Ehijiagbone and Olatokun (2020) discovered that the lack of necessary criteria such as rewards, incentives, organisational policy on tacit knowledge exchange, or an adequate environment are inhibitors for knowledge sharing. Salary increases, bonuses, job security, and other factors must, therefore, be considered as incentives (Fullwood et al, 2013).

Knowledge sharing remains challenging to implement in underdeveloped nations because it takes a favourable attitude to share knowledge voluntarily (Mazorodze and Mkhize, 2022). Since coercing instructors to share

knowledge is immoral, it is necessary to raise awareness of the importance of sharing knowledge so that LIS educators can respond positively. Despite the fact that Nigeria has more public and private universities, there is concern regarding professors' low performance in terms of teaching and research. This demonstrates that professors, who are at the forefront of knowledge acquisition, have yet to properly leverage the existing information sharing platforms to improve their competitive advantage. Poor workplace performance can be attributed to a variety of causes, including the LIS educators' unwillingness to share their experience with other members of the organisation, which may have a negative impact on performance. That is why this study sought to investigate the attitudes of LIS instructors regarding information sharing in South-west Nigerian universities.

Objectives of the Study

The main purpose of the study was to investigate LIS educators' attitude toward knowledge sharing practices of universities in South-west, Nigeria. The goals of the study were to specifically:

i. determine the knowledge sharing practices of LIS educators in universities in South-west Nigeria;

ii. examine the attitudes of LIS educators towards knowledge sharing practices in South-west, Nigeria

Research Questions

i. What are the knowledge sharing practices among LIS educators in universities in South-West, Nigeria?

ii. What are the attitudes of LIS educators towards knowledge sharing practices in South-west, Nigeria?

Literature Review

For LIS teachers, talking to each other about what they know is not just a nice idea; it is something they really need to do if they want to keep up with the way education is changing. When lecturers share ideas and experiences, they get to hear about new tools, fresh teaching methods, and better ways to help their students succeed. Research has shown just how powerful this can be. For instance, Olatokun et al. (2024) discovered that when LIS lecturers in Nigerian universities shared information, it influenced how they use

MOOCs (Massive Open Online Courses) which are fast becoming a modern way of teaching. In another example, Inyang (2022), in a study at the University of Calabar, talked about how mentoring and working together helps LIS teachers feel like they belong to a community and makes it easier for them to solve problems in their work.

Sharing knowledge helps lecturers stay informed, work better together, and keep their teaching methods fresh and relevant. However, it all comes down to attitude, how a person thinks, feels, and plans to act towards a person, group, activity, or idea. Attitudes can be good or bad. If the attitude is affirmative towards a deed, then it can be termed as positive. The Theory of Reasoned Action (TRA) is utilised to measure a person's attitude towards the knowledge sharing behaviour that, in turn, can affect the inclination of a person to share the knowledge. The TRA tells us how somebody's conduct is determined by their desire to do something (Ajzen & Fishbein, 1980). The theory tells us that intention is influenced by attitude towards an action andsubjective norm. ,

In terms of knowledge sharing, one's attitude and subjective norms drive intention to share. Knowledge sharing is very significant to educators and learners because it leads to new knowledge generation. Areekkuzhiyil (2019) researched the Kerala, India undergraduates and investigated the attitude towards knowledge sharing and reached the conclusion that there exists a positive attitude towards knowledge sharing among the students. A cross-sectional research design was adopted in the research, with a representative sample of 400 students belonging to different departments. The research concluded that there is positive attitude towards knowledge sharing. Likewise, the studies demonstrate that attitude towards knowledge sharing differed significantly by gender, study stream and institution type. Various studies place greater emphasis on the importance of knowledge sharing in education. A study by Xu and Li (2022) placed greater emphasis on how crucial knowledge sharing is for professional development and competitive edge among educational institutions.

Adu and Olowu (2022) focused on the promotion of acceptable norms for knowledge sharing in developing countries like Nigeria and the need for teaching practices that are relevant to the community. Onifade (2015) conducted another study on knowledge sharing among Nigerian federal universities, using a questionnaire to obtain data from 362 librarians. The

study found a positive attitude toward knowledge sharing. However, the practice of knowledge sharing among the library professionals was low. The knowledge being shared was mostly by word of mouth, workshop and seminar.

Awodoyin et al. (2016) also looked into librarians' knowledge-sharing practices in selected Nigerian academic libraries. Their study found that librarians may share knowledge through newsletters, mobile phones, face-to-face communication, and email, which improves emotional relief, efficiency, innovation and effectiveness. However, information exchange has not yet been formally implemented in the academic context investigated. It was suggested that information sharing become a routine that management of the studies library should implement.

Ehijiagbone and Olatokun (2020) investigated tacit knowledge-sharing (KS) practices of thirty-one purposively selected academics at the University of Ibadan in Nigeria. Using a case study research approach, the study investigated the availability of tacit knowledge sharing culture and practices, the factors influencing tacit knowledge sharing, and how the University facilitates the sharing of this type of knowledge. The study foundb that there is a widespread culture of information sharing among professors, and that they share tacit knowledge through personal encounters, conversations, and, most importantly, seminars. They identified communication, lecturers' willingness to share tacit knowledge, the presence of cordial relationships, the availability of constant electricity in offices and the university environment, and a platform for older lecturers to mentor younger ones as factors that positively influence their tacit knowledge sharing. The study revealed that there is little sharing of tacit knowledge among professors. The provision of a platform for sharing tacit knowledge, the inclusion of a reward system, and an enabling atmosphere were all advocated. According to Olatokun and Elueze's (2012) study findings, the level of information technology (IT) utilisation has a substantial influence on knowledge sharing behaviour. More IT infrastructure and services that promote beneficial knowledge sharing were advocated.

Methodology

Using a descriptive survey methodology, the population consisted of four hundred and eight Library and Information Science (LIS) educators from South-West Nigeria. The overall population included academic librarians and

academic personnel from Library and Information Science Departments at universities in South-West Nigeria. Library and Information Science Educators are university lecturers/educators who are in charge of training library personnel, as well as professionals who work in academic libraries and teach LIS-related courses at universities. A total enumeration technique was utilised to sample the entire population. The data collection instrument was a questionnaire, with 334 copies found usable with a response rate of 69.5%. Data analysis was done through descriptive statistics.

Results and Discussion of the Findings

The demographics of the respondents are presented in Table 1.

Table 1: Demographic characteristics of the Respondents

Demographic Variables		Frequency	Percentage
Gender	Female	181	54.2
	Male	153	45.8
	Total	**334**	**100**
Age Range			
	21 _30 years	63	18.9
	31_40 years	102	30.5
	41_50 years	103	30.8
	51_60 years	58	17.4
	Above 61 years	8	2.4
	Total	**334**	**100**
Qualification			
	PhD	92	27.6
	Masters	106	31.7
	Others	136	40.7
	Total	**334**	**100**

The results in Table 1 revealed 45.8% of the respondents were male while 54.2% were female. This indicates a higher proportion of female LIS Educators than their male counterparts in the surveyed universities. The results further revealed that most of the respondents were between ages 21-30years (18.9%) and 31-40 years (30.5%) while those above 60years were only 2.4%. This implies that majority of the respondents were active working age made up the majority of the respondents. The table also showed that the majority (59.3%) held a Masters degree while about 54% worked in the higher institution of learning for 1-10 years. This may imply that a higher percentage of respondents are early or mid-career LIS educators.

The results of the analysis based on the research questions are presented in Tables 2 and 3.

Table 2: Knowledge Sharing Practices among LIS Educators

Knowledge Sharing Practices	Strongly Disagree/Disagree	Strongly Agree/Agree	Mean	Std. Dev
I discuss about new knowledge formally with fellow colleagues	325(97.3%)	9(2.7%)	3.36	0.59
I use the internet to share new knowledge with other colleagues	318(95.2%)	16(4.8%)	3.35	0.58
I share new knowledge with others informally	306(91.6%)	28(8.4%)	3.32	0.65
I use the social media to share new knowledge	309(92.5%)	25(7.5%)	3.28	0.62
I share new knowledge through printed copies to other colleagues	286(85.6%)	48(14.4%)	3.18	0.72

According to the data in Table 2, respondents indicated knowledge-sharing activities among LIS educators. The findings revealed that having a formal discussion about new knowledge with co-workers has the greatest mean value (3.36). This is closely followed by LIS educators using the internet to share

new knowledge with other colleagues (mean = 3.35). However, of the other knowledge-sharing behaviours reported by the respondents, the distribution of printed copies of new knowledge to colleagues had the lowest mean value (3.18). The data showed that LIS teachers in the Nigerian region that was surveyed shared more information among themselves.

These findings on how LIS instructors share information relate closely to earlier studies by Howell and Annansingh (2013), Awodoyin et al. (2016), and Akosile and Olatokun (2020). For instance, consistent with the current study's observation that new knowledge is shared online and through technical means, Awodoyin et al. (2016) found that LIS professionals exchange information not only face-to-face but also via mobile phones, email, and newsletters. This multi-channel approach fosters innovation, improves efficiency and effectiveness, and supports emotional well-being, reinforcing the present study's conclusion about the value of technology in knowledge sharing among educators.

Similarly, Ehijiagbone and Olatokun (2020) stressed the importance of information sharing among lecturers, echoing this study's findings on the role of formal discussions in spreading new knowledge. Their research showed that LIS instructors effectively share tacit knowledge through personal interactions, conversations, and seminars, demonstrating the combined value of both formal and informal methods. Together, these studies highlighted how blending traditional and technology-driven approaches creates a more collaborative, innovative, and professionally enriching environment within the LIS field.

Table 3: LIS Educators' Attitude towards Knowledge Sharing

Attitude towards Knowledge Sharing	Strongly Disagree/Disagree	Strongly Agree/Agree	Mean	Std. Dev
I feel that I acquire new knowledge by sharing knowledge and experience	4(1.2%)	330(98.8%)	3.57	0.52
I feel that professional development is enhanced by sharing	5(1.5%)	329(98.5%)	3.52	0.56

knowledge in teaching and research				
I understand the importance of sharing knowledge in teaching and research	5(1.5%)	329(98.5%)	3.46	0.54
I feel that I save time when I share teaching materials with colleagues	25(7.5%)	309(92.5%)	3.33	0.69
I feel that sharing knowledge and transferring experience enhances social interaction	99(29.7%)	235(70.3%)	2.93	0.89

The results in Table 3 show that respondents felt sharing their knowledge and experiences helps them gain new insights (mean score: 3.57). They also agreed that exchanging knowledge in teaching and research plays a key role in their professional development (mean score: 3.52). Put simply, the LIS instructors surveyed clearly see information sharing as a positive and valuable practice.

Ajzen and Fishbein's (1975) work suggested that what people do is largely shaped by their intention to act, and that intention is influenced by how they feel about the activity itself. In other words, when someone has a positive attitude combined with social encouragement, they're more likely to follow through, which can lead to a better performance. In this study, the findings showed that LIS educators generally have a positive attitude towards sharing information, which means they're willing to take part in such practices. This aligns with earlier findings. For example, Onifade (2015) and Fayda-Kinik (2022) both found that educators tend to view information sharing favourably. Fayda-Kinik (2022) noted that faculty members were open and ready to share what they knew, while Quadri (2019) observed a similar pattern among LIS professionals in university libraries across South-west Nigeria. The trend is not unique to Nigeria. Abd-Mutalib et al. (2023) found that among Korean educators, a positive attitude towards information sharing went hand in hand

with a strong intention to share. Taken together, these studies pointed to the same conclusion: cultivating the right attitude towards knowledge sharing is a key step in boosting collaboration among LIS educators; and that collaboration is an important driver of professional growth.

Conclusion and Recommendations

For any educator who wants to grow in their career, publish stronger research, and stay relevant, sharing knowledge is key. The same goes for universities; they can't thrive or last without it. This study examined how Library and Information Science (LIS) lecturers in South-west Nigerian universities share what they know. Three main methods stood out: formal discussions, the use of ICT tools, and, less often, sharing printed materials. Formal discussions, whether in conferences, seminars, or presentations, remain a favourite. They give colleagues a chance to exchange ideas, learn from each other, and work as a team. Technology is also playing a big role. Many lecturers now share information online and use digital tools to make communication faster and access to knowledge easier. Printed hand-outs, however, are rare, probably because printing costs are high. One good sign is that most LIS educators actually want to share knowledge; they have a positive attitude towards it. The challenge is making it a consistent habit. To push this forward, the study suggested three things. First, educators should intentionally build a culture of sharing, which opens minds and strengthens collaboration. Second, universities should introduce rewards and incentives to encourage it, especially for younger lecturers. And third, NALISE (the National Association of Library and Information Science Educators) could champion a mentor–mentee system to pair experienced lecturers with newer ones. This would make sharing second nature and boost professional growth across the board.

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CHAPTER FIVE

Cross-Border Digital Education: Challenges and Opportunities for Universal Learning Access

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Abstract

Cross-border digital education offers immense potential to expand global learning access, yet it is challenged by technological inequalities, digital literacy gaps, language barriers, and inconsistent regulatory frameworks. This study adopted a secondary data-based approach, drawing insights from existing reports and academic literature to examine how digital education can support inclusive and universal learning. The analysis highlighted critical obstacles such as inadequate infrastructure, limited affordability, and linguistic inaccessibility that continue to exclude marginalised learners. However, it also identified emerging opportunities, including the use of AI-driven learning platforms and international policy cooperation, to create more inclusive educational ecosystems. The study concluded that while digital tools can enhance educational outreach across borders, targeted reforms and scalable frameworks are necessary to ensure equity and sustainability. The study emphasised designing adaptable, culturally sensitive models that prioritise both access and quality to bridge the digital divide and enable lifelong learning for diverse populations globally.

Keywords: Cross-border, Digital Literacy, Education, Global Learning.

Introduction

In an increasingly globalised and digitally interconnected world, education is undergoing a profound transformation. The rise of cross-border digital education, defined as the provision of learning experiences across national boundaries via digital technologies, has introduced new paradigms of accessibility, scalability, and inclusiveness. While traditional education has long been bound by geographical, economic, and political constraints, digital modalities are beginning to transcend those limitations, offering unprecedented access to knowledge and skills for learners worldwide.

However, this transformation is neither linear nor universal. The very technologies that promise democratised learning often reinforce existing inequalities, particularly when cross-border implementation encounters disparities in infrastructure, policy, and digital literacy.

Global trends in online education reflect both optimism and complexity. According to Altbach and de Wit (2018), the internationalisation of higher education is increasingly being shaped by digital delivery models, with Massive Open Online Courses (MOOCs), hybrid programmes, and virtual exchange initiatives gaining traction across regions. The aspiration to provide equitable access to learning opportunities, regardless of geography, is echoed in the United Nations' Sustainable Development Goal 4 (SDG 4), which emphasises inclusive and equitable quality education for all. However, fulfilling this vision requires not only technological intervention, but also deep structural changes, particularly in how educational content is designed, delivered, regulated, and localised.

Recent academic literature has critically evaluated both the opportunities and limitations of cross-border digital education. For instance, Knight and McNamara (2017) argued that although cross-border e-learning programmes hold potential to expand access in low-income countries, they often reproduce neo-colonial knowledge hierarchies by privileging content and pedagogy from the Global North. This imbalance raises concerns about cultural homogenisation and the devaluation of indigenous learning systems. In contrast, Wang, Wang, and Shee (2020), through a study of international e-learning adoption in Southeast Asia, found that learner engagement and retention improved when digital platforms were localised both linguistically and culturally. This suggests that meaningful cross-border education must be both globally accessible and locally relevant.

Yet, even with promising models, several enduring challenges persist. Technological infrastructure is perhaps the most visible barrier. While countries such as South Korea and Estonia have achieved near-universal internet access, large swathes of Sub-Saharan Africa and South Asia still struggle with unreliable connectivity and digital device shortages (ITU, 2023). This disparity reinforces a digital divide that limits educational participation across borders, particularly among historically marginalised groups such as rural learners, women, and persons with disabilities. Moreover, lack of

institutional interoperability, where qualifications, assessments, and learning credentials are not recognised across national borders, creates further friction in the mobility and utility of cross-border digital education (Chakroun & Keevy, 2018).

Regulatory misalignment poses another critical issue. Unlike physical universities operating within well-defined national frameworks, digital education providers often navigate a fragmented policy landscape where intellectual property rights, data privacy laws, and quality assurance standards vary significantly. For instance, while the European Higher Education Area (EHEA) has taken coordinated steps to ensure cross-national credit recognition through the Bologna Process, similar mechanisms are largely absent in Africa, Latin America, and parts of Asia (Marginson, 2020). These discrepancies hinder the portability and legitimacy of digital learning credentials, undermining their value in transnational labour markets.

Despite these challenges, innovative solutions continue to emerge. AI-enabled learning systems, blockchain-based credentialing, and multilingual learning platforms have been heralded as breakthroughs in making digital education more personalised, secure, and inclusive. For example, UNESCO (2022a) highlights the use of AI to create adaptive learning environments that cater to individual learners' pace and style, particularly in multilingual or under-resourced contexts. Moreover, collaborative initiatives like the African Virtual University (AVU) and India's SWAYAM have demonstrated scalable models that blend public policy with open-access technologies to expand cross-border learning access in the Global South.

It is important, however, to recognise that technological innovations cannot succeed in isolation. Cultural sensitivities, ethical concerns, and institutional buy-in are equally critical to the sustainability of cross-border digital education. As Singh and Elahi (2021) noted, the success of global e-learning platforms depends not only on bandwidth and algorithms, but also on pedagogical trust, learner autonomy, and the mutual recognition of academic standards. The notion of "universal access" must thus be reinterpreted—not as a one-size-fits-all solution, but as a pluralistic ecosystem where digital pathways are tailored to the diverse needs, constraints, and aspirations of learners around the world.

This research paper sought to examine these dynamics with greater granularity. While most existing studies focused either on the technological aspects or the policy frameworks of cross-border education, few explored how these dimensions interact with one another to either facilitate or hinder universal access. Through a critical review of secondary sources, this study aimed at unpacking the multidimensional challenges, ranging from infrastructure and digital literacy to governance and equity, and the parallel opportunities arising from AI tools, multilingual platforms, and global collaborations. Ultimately, this inquiry did not approach digital education as a neutral or inevitable evolution, but as a contested space where power, access, and innovation are in constant negotiation. The central question, therefore, is not just how to expand digital learning across borders, but how to do so in ways that is equitable, culturally inclusive, and contextually sustainable. Addressing this question requires a nuanced understanding of both systemic constraints and emergent possibilities—a balance this paper aimed to strike.

Review of Literature

Theoretical and Policy Foundations

The foundational moment for cross-border digital education can be traced to UNESCO's 2015 Qingdao Declaration**,** which called for harnessing ICT to ensure inclusive education, and, therefore, proposed frameworks for global credential recognition (UNESCO, 2015). This policy's emphasis laid groundwork for emerging research on transnational educational frameworks. Knight and McNamara (2017), writing in *Higher Education Quarterly*, explored quality assurance across international online programmes, highlighting significant disparities in accreditation standards and cautioning against assuming that digital delivery alone ensures academic legitimacy. Similarly, Marginson (2018), in *Studies in Higher Education,* emphasised that the credibility of cross-border qualifications depends not merely on technology adoption, but also on robust institutional coordination, policy coherence, and mutual trust.

Access and Infrastructure Disparities

Reliable infrastructure remains a persistent barrier to universal access. Reddy, Jose, and Vaidehi (2021) documented that learners in remote regions often contend with intermittent internet, outdated devices, and high data costs, which significantly undercut the democratising potential of online education.

These findings echoed those from the OECD (2023), which revealed that while broadband penetration is rising globally, rural and marginalised communities lag behind. The OECD (2023) strongly advocates embedding Universal Design for Learning (UDL) principles, ensuring that digital tools offer accessibility through flexible interfaces and multimodal content delivery. These technological and access-oriented frameworks, however, cannot stand alone; they must be complemented by social and institutional supports that recognise and adapt to learners' constraints.

Pedagogical Design and Learner Trust (2018–2022)

Access without quality can exacerbate educational inequities. Lund, Harrison, and Gemmell's (2025) study in *Education and Information Technologies* emphasised the complexity of developing cross-border digital courses that are both rigorous and responsive to diverse learner needs. Their interviews with international graduate students uncovered challenges related to clarity of expectations, cultural assumptions embedded in learning tasks, and the absence of community support—all factors that diminished learner trust and engagement. Complementing this, Hennessy (2021), in *Comparative Education,* demonstrated that teacher readiness, defined by cultural competence and digital pedagogy, served as a critical moderator in whether students engaged meaningfully with digital content. Without culturally attuned pedagogy, digital education can feel foreign and isolating to learners outside its dominant context.

MOOCs, Micro-credentials, and Modular Learning

MOOCs marked a widely discussed early model for scalable, cross-border education. Asyhari and Islamia (2023) compared self-regulation and motivational outcomes among Indonesian students engaging with MOOCs versus traditional classrooms, finding similar levels of self-regulated learning but consistently higher intrinsic motivation within face-to-face environments. This pattern suggests that while MOOCs enhance access, they may lack motivational structures inherent to in-person communities. On a related front, UNESCO (2022b) spotlighted micro-credentials as a flexible means to certify discrete skills globally. Yet, a 2023 thematic review (Springer, 2023) highlighted fragmentation in validation mechanisms, noting that learners often navigate inconsistent accreditation landscapes with patchy recognition across sectors. MOOCs and micro-credentials hold considerable promise, but their

potential remains limited unless ecosystems of trust and standardisation are built across borders.

Cultural, Linguistic, and Contextual Adaptation

Cross-border digital education must engage meaningfully with local contexts. Mays et al. (2022), in their comparative study of remote teaching in Sub-Saharan Africa, cautioned against importing standard English-medium curricula without adaptation, noting how such practices can marginalise local knowledge traditions and reduce learner motivation. Similarly, Pérez and Lee (2023), in *International Review of Research in Open and Distributed Learning*, reported that bilingual course delivery significantly improved learner engagement in Latin America and Southeast Asia, yet most digital platforms remain monolingual—rooted in global English norms. These studies underscored the importance of culturally responsive curriculum design and the privileging of local epistemologies alongside global perspectives.

Equity, Inclusion, and the Digital Divide (2020–2025)

The COVID-19 pandemic brought digital inequities into sharper relief. A large-scale review by Johnson and Turner (2021) found that participation among students from low-income households plummeted by 30–40% when education shifted online. Equally, digital literacy issues emerged not just from access gaps but from unfamiliarity with online learning environments, reducing both participation and academic outcomes (Liang et al., 2022). UNESCO's 2023 report on digital inclusion emphasised that equitable access strategy must encompass device provision, connectivity, digital skills training, and ongoing technical and emotional learner support.

Emerging Technologies: AI, Immersive Learning & Governance (2021–2025)

Innovations like AI, virtual reality (VR), and the metaverse hold transformative potential. Nwadinachi and Ivanov (2022), in *Computers & Education*, surveyed AI applications in cross-border programmes and found enhanced personalisation but raised concerns over algorithmic transparency, data privacy, and uneven infrastructure between regions. VatandoustMohammadieh et al. (2024) proposed an AI-driven scaffolding framework aiming to support diverse learners at scale; yet they admitted that real-world pilots remain limited and largely confined to high-resource

contexts. Additionally, Jagatheesaperumal et al. (2022) warned that immersive technologies might exoticise rather than engage global learners if cultural localisation is sidelined. Though promising, these advanced technologies risk replicating access inequities unless carefully guided by ethical, culturally sensitive strategies.

The corpus of literature from 2015 to mid-2025 paints a landscape of ambitious potential entwined with persistent structural challenges. Although access continues to expand through digital networks and platforms, the inequities of infrastructure, cultural misalignment, limited accreditation frameworks, and underdeveloped technological governance undermine the realisation of universal learning. A pressing need exists for integrative, cross-contextual frameworks and empirically validated interventions that are not only digitally accessible, but also pedagogically rich, culturally resonant, and institutionally credible.

Research Gaps

Despite significant advancements in digital learning technologies and a growing global emphasis on equitable access, several critical research gaps persist in the domain of cross-border digital education. First, while numerous studies have explored digital infrastructure disparities (Reddy et al., 2021; OECD, 2023), there is limited work on how infrastructure interacts with pedagogical models and digital literacy in cross-border settings. Most discussions isolate access from actual learning experiences, overlooking how technology, pedagogy, and learner capability influence one another.

Second, existing research often highlights cultural and linguistic barriers (Mays et al., 2022; Pérez & Lee, 2023), but few studies have evaluated scalable frameworks for integrating local content or languages into global digital platforms. Localisation remains superficial in most global e-learning programmes, lacking depth in cultural relevance and epistemological inclusion. Third, while micro-credentials and MOOCs are widely studied (Asyhari & Islamia, 2023), their regulatory acceptance across borders is inconsistent. There's a clear gap in comparative research that evaluates how digital qualifications are recognised (or rejected) by educational and labour market institutions in different countries. Although emerging technologies like AI and VR are hailed as potential equalisers (VatandoustMohammadieh et al., 2024; Nwadinachi & Ivanov, 2022), little is known about their actual

application in low-resource or multilingual environments. Many models remain theoretical or are piloted only in high-income countries.

A key gap remains in developing an integrated understanding of how cross-border digital education can be made both inclusive and scalable, while ensuring pedagogical effectiveness, cultural relevance, and alignment with diverse policy frameworks.

Research Objectives

Based on the identified gaps, the objectives of this study were to:

1. investigate the key barriers—technological, economic, linguistic, and regulatory—that limit equitable access to cross-border digital education;
2. explore the role of AI-driven technologies and international policy collaboration in creating scalable models for inclusive digital learning across borders; and
3. critically analyse existing secondary data and scholarly literature to identify effective strategies and policy frameworks that can bridge the global digital divide in education.

Methodology

This study adopted a qualitative, exploratory research methodology grounded in the analysis of secondary data. Given the global and complex nature of cross-border digital education, this approach is appropriate for synthesising insights across diverse geographical, technological, and policy contexts. The study drew on a wide range of scholarly articles, policy papers, and institutional reports published between 2015 and 2025 in reputed journals and platforms such as SCOPUS, Springer, ABDC, and UNESCO. A purposive sampling strategy was employed to select literature relevant to the themes of digital accessibility, cross-border learning, and equity in education. The collected data were analysed thematically, identifying recurring patterns and gaps in areas such as infrastructure, digital literacy, regulatory frameworks, and technological innovations like AI. This method allowed for a nuanced understanding of how challenges and opportunities intersect in digital education across borders; and it provided a solid foundation for proposing scalable and inclusive models for universal learning access.

Data Analysis

Cross-border digital education occupies a paradoxical space—at once aspirational and fragmented. With a large and growing population of school-aged learners and an expanding higher education landscape, some regions are uniquely positioned to benefit from the opportunities presented by global digital education initiatives. Yet, disparities in digital access, linguistic diversity, regulatory rigidity, and infrastructural inequality continue to hinder its realisation of universal, borderless learning.

Infrastructural Asymmetry: The Uneven Geography of Access

At the core of the challenges surrounding cross-border digital education lies a persistent digital infrastructure gap. While urban areas in many regions are witnessing improved internet access and technology adoption, rural and remote communities often remain under-connected. This divide is more than a matter of connectivity—it reflects deeper patterns of educational exclusion shaped by geography, language, socio-economic status, and institutional reach. Although private digital learning platforms have accelerated the spread of online educational content, their access remains uneven, often favouring urban, tech-savvy, and linguistically privileged groups. The disparity becomes even more evident in border or hard-to-reach regions, where basic digital infrastructure, such as broadband, electricity, and reliable hardware, is inconsistent or entirely lacking. Efforts to expand digital education through policy and public infrastructure initiatives face challenges in last-mile implementation. While mobile internet access has improved in many places, affordability and accessibility do not always translate into meaningful educational experiences. Learning on small, low-end devices often shared among multiple users can limit engagement, especially with global courses that require real-time interaction, sustained connectivity, and adequate processing capacity. In such contexts, students are not simply underserved; they are structurally excluded from the digital learning revolution.

Digital Literacy: A Fragmented Terrain of Skills and Assumptions

Beyond infrastructure, digital literacy emerges as a critical yet often misunderstood barrier to equitable digital education. The popular belief that younger generations are naturally proficient with technology does not always hold true upon closer inspection. Familiarity with social media, entertainment platforms, or basic device usage does not necessarily translate into the skills

required for academic engagement in digital environments. The ability to navigate online learning platforms, manage digital assignments, or participate meaningfully in virtual classrooms often requires a very different set of competencies. This challenge becomes even more complex in multilingual societies, where the dominance of a single global language—often English—on cross-border education platforms creates an invisible barrier for many learners. Those who are not fluent in the language of instruction, especially women, first-generation learners, or individuals from underrepresented linguistic backgrounds, often find themselves excluded from meaningful participation.

Even where open online courses exist to expand access, limited localisation of content and inadequate learner support can undermine their effectiveness. Without attention to regional languages, culturally relevant materials, and inclusive pedagogical approaches, such platforms risk reinforcing educational divides rather than bridging them. The promise of democratising education through digital means is compromised when language, literacy, and learner context are overlooked- transforming a tool of empowerment into yet another gatekeeper of opportunity.

Regulatory Fragmentation and Credential Incompatibility

The regulatory landscape for digital education in many regions remains fragmented and lacks the coherence needed to support international recognition of online credentials. While some national authorities have begun approving fully online degree programmes and a few cross-border collaborations with renowned global universities have emerged, these efforts are often isolated rather than part of a coordinated strategy. Credentials earned through online platforms—such as MOOCs or micro-certifications—frequently face challenges in being recognised by employers or academic institutions, particularly when not associated with high-profile international brands. Conversely, qualifications awarded by domestic digital education providers often encounter skepticism abroad, largely due to concerns over quality assurance and standardisation. This lack of mutual recognition limits the mobility of learners and the transferability of skills across borders. A student may acquire valuable competencies through an online global course, but whether those skills are accepted for employment or further education in another country remains uncertain. Further complicating the issue, many

academic institutions remain cautious in forming cross-border digital partnerships. Barriers include bureaucratic processes, inflexible accreditation systems, and concerns over curricular autonomy. As a result, international collaborations in digital education are frequently more symbolic than strategic, lacking in depth, scale, or sustained impact. Without aligned policies to support learning equivalency, quality benchmarks, and reciprocal credit transfer mechanisms, the vision of seamless cross-border digital education remains difficult to realise.

Emergence of AI-Driven Opportunities and Adaptive Models

Despite ongoing challenges, there are promising signs of innovation in the digital education landscape. AI-powered educational technologies are beginning to offer more personalised and inclusive learning experiences. Some platforms now leverage Artificial Intelligence to respond to individual learner queries with customised explanations in local languages, while others use adaptive learning techniques to tailor content, offer career guidance, and assess skills based on user profiles. These emerging tools signal a potential shift in approach: instead of requiring learners to conform to rigid, standardised global content, technology can be harnessed to adapt that content to individual needs and contexts. When integrated with localised data, AI systems can predict dropout risks, suggest relevant learning resources, and adjust instructional pacing in real time to improve engagement and outcomes.

However, such innovations remain at a relatively early stage and are often developed in isolation, without meaningful integration into national education systems or public policy frameworks. Most current deployments are led by private ventures with commercial objectives, and this limits their reach and scalability. Without well-structured public-private collaborations, the transformative potential of these technologies risks being confined to those with the means to access them, rather than serving as inclusive solutions capable of reshaping education systems at scale.

Cultural Dissonance and the Politics of Knowledge

One of the more subtle yet deeply impactful barriers to cross-border digital education lies in the politics of knowledge itself. Many global learning platforms are shaped by dominant pedagogical traditions, case studies, and epistemologies that often reflect Western or Eurocentric worldviews. This can create a sense of cultural dissonance for learners in other parts of the world,

where the curriculum may feel distant from local contexts and realities. For example, a student studying marketing might encounter case studies centred on global financial hubs, with limited relevance to their own economic environment. This disconnect can lead to disengagement and the perception that global knowledge is foreign, elite, or inaccessible.

Moreover, there remains a lack of meaningful participation from diverse educational communities in the co-creation of content on international platforms. While educators from various backgrounds may contribute to global courses, their perspectives are often not grounded in local languages, regional examples, or culturally relevant case material. This imbalance affects not only cultural representation but also comprehension and practical applicability. In addition, social structures, such as those shaped by religion, gender norms, or other identity, based hierarchies, continue to influence access to digital education in ways that are often overlooked. Factors like access to personal devices, family support for online learning, and opportunities for internships or global exchanges are frequently mediated by these deeper societal dynamics. Analyses that ignore such forces risk offering an incomplete or overly sanitised view of educational access and inclusion. For digital education to be truly equitable and global, it must engage with these contextual realities—both in content and in delivery.

Institutional Readiness and Pedagogical Innovation

Indian higher education institutions, particularly public universities, are at varying levels of readiness to embrace cross-border digital models. The National Education Policy (NEP) (2020) has opened new pathways for online degrees and international collaborations, but implementation remains uneven. Faculty development in digital pedagogy is limited, and most teachers still rely on lecture-heavy formats that do not translate well into online delivery. There are encouraging exceptions where cross-border digital education programmes have demonstrated positive outcomes, particularly when supported by interactive features such as peer discussion forums, local facilitators, and blended assessment methods. These initiatives show that when thoughtfully designed, digital education can foster engagement and learning across diverse contexts. However, such examples remain isolated rather than widespread. Without broader investments in pedagogical training,

curriculum redesign, and institutional support systems, the momentum of digital learning will remain fragile and uneven.

To ensure lasting impact, international collaborations in digital education must evolve beyond symbolic agreements or memoranda of understanding. What are needed are deeper, reciprocal partnerships that include joint curriculum development, dual degree pathways, and co-teaching arrangements. These approaches can enhance both the quality and relevance of educational content, while fostering greater trust and cooperation between institutions across borders.

Findings and Interpretation

The investigation into cross-border digital education using data analysis yields a number of critical findings. These findings, though rooted in secondary data, are analysed with the lens of the study's core objectives: identifying barriers, exploring enablers, and interpreting the potential of policy-tech collaborations to bridge digital inequities in education. Rather than isolating variables, the analysis emphasises relational insights—how structural, technological, cultural, and institutional dimensions intersect.

The Illusion of Digital Ubiquity

Contrary to popular narratives of a global leap into a digital education era, the reality on the ground remains uneven and fragmented. While there are high numbers of internet users and growing smartphone penetration, it often obscures significant disparities in meaningful digital access. The findings suggest that having a device or an internet connection does not automatically translate into inclusive or effective educational experiences. For learners in low-income, rural, or linguistically marginalised communities, access is frequently limited, shared among multiple users, and subject to instability. This highlights that the so-called "digital access revolution" is often overstated in structural terms and underwhelming in pedagogical impact. When educational technologies operate in isolation—without adequate institutional support, training, or localised relevance—they risk becoming symbolic rather than transformative. These insights align with the concerns raised by Reddy et al. (2021) and OECD (2023), emphasising that access alone does not guarantee engagement or equitable learning outcomes.

Language and Literacy as Invisible Barriers

A significant and often underexplored insight is the depth of language as a gatekeeper in cross-border digital education. While India boasts over 20 official languages and hundreds of dialects, most global digital education platforms, including MOOCs and AI-driven tools, operate almost exclusively in English. The mismatch is not only linguistic but epistemological. The study found that learners often struggle not because they lack intelligence or motivation, but because the design of content assumes cultural fluency in academic norms. This linguistic dominance marginalises regional learners and often erodes self-confidence. Interpretation suggests that without sustained investment in multilingual content, interface localisation, and culturally relevant case examples, cross-border education will remain exclusionary. Even national platforms like SWAYAM, NPTEL etc., which offer some courses in Hindi and regional languages, fall short of addressing this complexity. Translation is not equivalent to localisation. Mere linguistic conversion cannot substitute for pedagogical redesign that aligns with learners' social realities and cognitive schemas.

Pedagogical Incongruence in Cross-border Offerings

One of the more nuanced findings is that global digital education models often reflect pedagogical assumptions alien to Indian learners and educators. For instance, asynchronous, self-paced modules assume a high degree of learner autonomy and digital navigation skills—attributes more commonly found in high-resource, individualised education systems. In contrast, Indian learners are more familiar with hierarchical, instructor-led, exam-oriented systems. As a result, the design of global online programmes often mismatches with learners' educational conditioning, leading to cognitive overload, dropout, or disengagement. Interpreting this, we arrive at a critical contradiction: while technology enables borderless access, pedagogy often enforces new, invisible borders. Without rethinking instructional design for cross-border contexts, especially in developing nations, digital education may replicate the very exclusions it seeks to overcome.

Fragmented Regulatory Ecosystem and Weak Credential Portability

The study found that higher education system lacks a coherent framework for integrating international digital credentials. UGC regulations allow online degree delivery, but recognition of foreign MOOCs, micro-credentials, or

short-term digital courses is still ambiguous. This has two implications. First, learners taking cross-border digital courses may not gain formal academic or employment credit for their efforts. Second, digital degrees may face skepticism abroad, especially in those nations with more centralised quality assurance mechanisms. This regulatory mismatch creates a hidden cost of participation. Learners invest time and resources into programmes whose utility remains uncertain. The interpretation here is that cross-border digital education cannot scale meaningfully without synchronised accreditation systems that establish mutual trust, reciprocity, and standardisation. The findings supported calls by Knight and McNamara (2017) and Marginson (2018) for greater harmonisation in global higher education policy.

Potential of AI, But Unresolved Ethical and Access Questions

The major insight concerns the promise, and pitfalls, of AI-driven personalisation. Tools like adaptive assessments, chatbots, and automated feedback engines offer real-time learner support at scale. In theory, this could mitigate teacher shortages, enable multilingual interfaces, and detect dropout risks early. However, the most AI applications in digital education are driven by private sector innovations, disconnected from public education systems and absent from policy frameworks. The absence of regulation around algorithmic fairness, data privacy, and local language adaptation raises red flags. Interpretation suggests that while AI offers immense potential, its success depends on its integration into inclusive public infrastructures. Without that, it may reinforce the divide between elite learners who can afford intelligent tutors and the masses who receive static, impersonal content.

Conclusion

The evolution of digital education has opened unprecedented opportunities for learners to access knowledge beyond borders. With the rapid expansion of digital infrastructure, international academic partnerships, and virtual learning platforms, cross-border education is no longer a distant dream - it is a living reality. However, this transformation is far from complete or evenly distributed. While the surface shows promise, a deeper examination reveals enduring gaps that challenge the vision of truly universal learning access. Digital education, by design, aims to dissolve geographical boundaries and democratise knowledge. Yet, in practice, the benefits often remain concentrated among populations that already have access to stable internet,

digital literacy, and institutional support. Many learners, particularly in low-income, rural, or marginalised communities, face persistent barriers, such as lack of connectivity, high costs of digital devices, limited language options, and rigid academic systems that fail to recognise alternative learning credentials. These issues highlight the stark difference between technological availability and meaningful educational inclusion. Moreover, the current structure of cross-border digital learning often centres on one-size-fits-all approach, where content delivery is prioritised over cultural understanding and contextual relevance. Educational models, learning materials, and evaluation methods are frequently shaped by dominant academic systems, leaving little room for local knowledge, languages, or culturally specific learning needs. This asymmetry not only limits learner engagement, but also questions the authenticity and fairness of knowledge transfer across global contexts.

For cross-border digital education to evolve into a more just and impactful system, it must embrace a broader, more human-centric philosophy. It is no longer sufficient to focus solely on platforms, content, or scalability. The future demands education systems that are empathetic, inclusive, and adaptable. This includes the need for pedagogy that respects diverse learning styles, support systems that bridge digital divides and credentialing mechanisms that ensure global recognition and mobility for all learners. In this new educational paradigm, linguistic inclusivity must take centre stage. Many learners are excluded not because of lack of ability, but because the language of instruction remains unfamiliar. Integrating multilingual content and translation tools is vital to lowering this invisible barrier. Similarly, culturally responsive teaching should become the norm—not the exception—so that learners feel seen, valued, and understood within digital classrooms that span continents.

Equally important is the recognition and portability of digital learning credentials. Without frameworks for mutual recognition, the promise of online education loses its practical value. Learners must be assured that the time and effort they invest in digital learning will be accepted and respected across institutions, industries, and borders. In short, the journey toward inclusive cross-border digital education is not merely a technological challenge, but a deeply philosophical one. It calls for global collaboration, policy innovation, and a willingness to listen to the voices of learners from all walks of life. By

shifting our focus from access alone to access with equity, empathy, and cultural awareness, we can begin to build a digital education ecosystem that is truly transformative and genuinely global.

Future Implications

Looking forward, this research highlighted several critical directions:

1. **Localised Innovation**: AI and digital platforms must be re-engineered for multilingual, low-resource environments. Public-private partnerships should focus on inclusive design rather than tech branding.
2. **Policy Synchronisation**: Regulatory bodies must work with other counterparts to establish frameworks for credit transfer, recognition, and shared quality assurance.
3. **Cultural Collaboration**: Cross-border programmes should prioritise co-creation with Indian educators and learners, embedding local knowledge systems and regional realities into global curricula.
4. **Inclusive Infrastructure**: Investment must move from broadband expansion to whole-ecosystem support—device access, digital literacy training, emotional well-being, and peer networks.
5. **Longitudinal Research**: Other empirical studies can be done to track learner's journey across digital borders—what helps them thrive, what causes dropout, and what enables transformation.

Limitations of This Research

While this study has presented a detailed thematic analysis using high-quality secondary sources, several limitations are acknowledged. First, the absence of primary field data means the study is interpretive rather than statistically validated. Second, the focus on a country may limit universality, though it provides a rich case of both opportunities and constraints. Third, the pace of technological change means that findings, especially related to AI, may rapidly evolve. Finally, while this paper emphasised inclusivity and equity, the intersectional analysis (e.g., caste, gender, disability) could be explored in greater depth in future studies.

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CHAPTER SIX

International Partnerships and Collaborations: University of Ilorin Strategies

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Abstract

This study examined the role of international partnerships and collaborations at the University of Ilorin, focusing on their multifaceted significance in enhancing academic quality, fostering research innovation, and promoting global engagement. The research sought to illuminate how these collaborations contribute to a more dynamic and enriched educational environment. International partnerships facilitate the exchange of ideas, knowledge, and best practices, which not only elevate the quality of academic programmes but also enable faculty and students to engage in cutting-edge research initiatives. Through a qualitative analysis of existing partnerships with foreign institutions, this research identified the various dimensions of collaboration, including student and faculty exchanges, joint research initiatives, and curriculum development. This study employed a qualitative research approach to investigate the international partnerships and collaborations at the University of Ilorin. , The findings revealed that these partnerships not only broaden the educational experience for students but also foster a culture of academic excellence and innovation within the university. Furthermore, the study identified the challenges and opportunities associated with these international collaborations such as funding constraints and cultural differences. With a critical insight into the University of Ilorin's strategic approach to global partnerships, this research contributed to a deeper understanding of how such collaborations can positively influence higher education in Nigeria. The study underscored the importance of establishing robust international links to prepare students for a globalised workforce and to enhance the university's reputation on the international stage.

Keywords: Partnership, Collaboration, University of Ilorin, Strategies

Introduction

In an increasingly globalised world, internationalisation of universities has become a strategic imperative for higher education institutions seeking to enhance their academic reputation, foster research collaborations, and provide students with a global perspective. One effective approach to achieve this is through partnerships and inter-university linkages. These collaborations enable universities to share resources, expertise, and experiences, creating mutually beneficial opportunities for academic and cultural exchange. Unilorin is a university that has engaged in internationalisation of its campus and programmes right from its establishment in 1975. The drive was consciously pursued since 2009 with the creation of the Centre for International Education (CIE) in the university. The aim of this study, therefore, is to examine the effectiveness of common tools and strategies of intenationalisation in university education, using Unilorin as a case study. Descriptive and historical methods were adopted for the study.

This study examined specific partnerships and inter-university linkages that Unilorin has established, highlighting their impact on the university's internationalisation efforts. It explored the strategies employed by Unilorin to forge successful collaborations, the outcomes achieved, and the lessons learned along the way.

Importance of Partnerships and Inter-University Linkages

Partnerships and inter-university linkages play a crucial role in the development and progress of higher education institutions. Collaborations foster an environment of mutual learning, growth, and knowledge exchange. On this note, we explored the importance of partnerships and inter-university linkages in the context of higher education with the following:

Enhanced Academic Opportunities

This refers to the expanded and enriched learning experiences that staff and students can gain through partnerships and inter-university linkages (Mario Jose, 2017). These opportunities go beyond the traditional classroom setting and provide staff and students with additional avenues for academic growth and development. Through partnerships and collaborations between universities, they can access a wider range of academic resources, expertise, and facilities. This can include shared libraries, research centers, laboratories,

and specialised equipment that may not be available at their home institution. These enhanced resources allow them to engage in more comprehensive and in-depth research, experimentation, and learning.

Furthermore, partnerships and inter-university linkages often facilitate the exchange of students and faculty members between institutions. This allows them to study abroad or attend courses and seminars at partner universities. Such exchanges expose them to different teaching styles, perspectives, and cultural experiences, broadening their horizons and enhancing their overall academic experience. It also promotes interdisciplinary collaboration. By bringing together students and faculty members from different disciplines and institutions, these collaborations foster the exchange of ideas, knowledge, and expertise across various fields. This interdisciplinary approach encourages innovation, creativity, and problem-solving skills, preparing students to tackle complex real-world challenges.

Moreover, enhanced academic opportunities through partnerships can also lead to joint research projects, conferences, and academic events. These collaborative initiatives provide platforms for networking, knowledge-sharing, and professional development. Students can interact with experts, scholars, and professionals from different institutions, expanding their academic and professional networks.

Research Collaboration

Research collaboration, according to Sergio Manrique (2018), is a fundamental aspect of scientific progress, enabling researchers to pool their expertise, resources and insights to address complex research questions and achieve breakthrough discoveries. Collaboration in research involves individuals or teams from different disciplines, institutions, or even countries working together on a shared research project or objective. Collaborative research offers numerous benefits. It fosters knowledge exchange, promotes a multidisciplinary approach, and enhances the quality and impact of research outcomes. By bringing together researchers with diverse backgrounds and perspectives, collaboration expands the scope of investigation, encourages innovative thinking, and increases the likelihood of addressing complex problems comprehensively. Another key advantages of research collaboration is the ability to leverage complementary skills and resources. Each collaborator can contribute unique expertise, methodologies, and technologies,

leading to more robust study design, data collection, and analysis. This synergy often leads to novel insights, accelerated progress, and greater research output. Research collaboration is not limited to a specific field or discipline. It can occur within scientific communities, academia, industry, and even across borders. In recent years, the rise of digital communication platforms and collaborative tools has further facilitated global research collaboration, breaking down geographical barriers and enabling real-time collaboration on shared projects. Several studies have highlighted the positive impact of research collaboration. A research paper by Wuchty, Jones, and Uzzi (2007) analysed over 19.9 million scientific articles and found that highly collaborative research papers tend to receive more citations, indicating their higher impact and visibility within the scientific community. Another study by Kingsley ., Henning, ., & Tollefson, . (2017) emphasised the positive correlation between collaboration and scientific productivity, demonstrating that greater collaboration leads to increased research output.

Cultural Exchange and Diversity

Cultural exchange refers to the interaction and sharing of ideas, values, customs, and artistic expressions between different cultures. It occurs through various means such as trade, migration, travel, and technological advancements. This exchange often leads to the enrichment and diversification of societies, as it fosters the blending and integration of different cultural elements (UNESCO, 2005). The resulting cultural diversity creates a vibrant tapestry of traditions, languages, arts, and beliefs. One of the notable outcomes of cultural exchange is the emergence of hybrid cultures, where elements from different cultures merge to form something new and unique. This blending of cultural influences can be seen in various aspects of human life, including language, cuisine, fashion, music, and visual arts (García Canclini, N. 1995). Cultural exchange also has a profound impact on literature and the arts. It allows for the exploration of different perspectives, narratives, and styles, broadening the horizons of creativity. When writers and artists are exposed to diverse cultures, they gain new insights and inspiration, which often find expression in their works. This cross-pollination of ideas and artistic techniques can lead to the birth of innovative literary movements and genres. Moreover, cultural diversity in literature promotes inclusivity and representation. It provides a platform for marginalised voices, allowing them to share their stories and experiences. Through diverse literary works, readers

gain a deeper understanding of different cultures, breaking down stereotypes and fostering empathy. This not only enriches the literary landscape but also contributes to building a more inclusive and tolerant society. Cultural exchange makes a university a truly globalised environment.

Resource Sharing and Capacity Building:

Collaborative partnerships enable universities to pool their resources and expertise, leading to cost-sharing and efficient utilisation of available facilities. Through joint initiatives, universities can share libraries, laboratories, and other infrastructure, thus expanding the range of resources accessible to students and researchers. Furthermore, universities can leverage each other's strengths to build capacity in areas where they may have limitations, thus enhancing overall institutional capabilities.

Promoting Student and Faculty Mobility

In today's interconnected world, promoting student and faculty mobility has become increasingly important in higher education. Student and faculty mobility refers to the exchange of students and academic staff between institutions and countries, allowing them to gain international experience, broaden their perspectives, and contribute to cultural exchange and diversity (Knight2017). Students and faculty members from different countries and backgrounds bring diverse perspectives, knowledge, and experiences to the host institution. This exchange fosters a rich learning environment, encourages critical thinking, and promotes cross-cultural understanding. When students and faculty members engage in mobility programmes, they gain exposure to different teaching methods, research approaches, and academic resources. This exposure enhances their learning experience and equips them with valuable skills, such as adaptability, intercultural communication, and global awareness (Deardorff,. 2009). Faculty mobility promotes research collaboration between institutions and countries. It allows scholars to work together on joint research projects, share expertise, and exchange innovative ideas. Such collaborations contribute to the advancement of knowledge and address global challenges through interdisciplinary cooperation. Promoting student and faculty mobility aligns with the broader goal of internationalising higher education institutions. It helps institutions attract a diverse student body, enhance their global reputation, and establish international partnerships. These efforts contribute to the development of a

globally competitive and culturally inclusive higher education sector (Altbach, ., & Knight, 2007). In conclusion, promoting student and faculty mobility is crucial for fostering academic and cultural exchange, enhancing the learning experience, encouraging research collaboration, and internationalising higher education.

An Overview of Unilorin's Internationalisation Efforts

The University of Ilorin (Unilorin) is committed to fostering internationalisation and global engagement within its academic community. Recognising the importance of cross-cultural exchange, diversity, and collaboration, Unilorin has implemented various initiatives to promote internationalisation and enhance its global presence. Its internationalisation efforts encompass several key areas, including student mobility, faculty exchange, research collaborations and partnerships with international institutions. These efforts aim to provide students and faculty members with valuable opportunities for academic and cultural enrichment while contributing to the university's academic excellence and global reputation. Unilorin's internationalisation infrastructure includes the Centre for International Education (CIE), which serves as a focal point for coordinating international programs, managing partnerships, and supporting students and faculty members engaged in international activities.

The CIE actively promotes faculty exchange programmes, allowing faculty members to collaborate with international counterparts, share expertise, and engage in joint research projects. These collaborations facilitate knowledge exchange, enhance research output, and advance academic disciplines. Additionally, Unilorin's faculty members participate in international conferences, workshops, and seminars, enriching their professional development and expanding their networks. The CIE also encourages student mobility by offering various study abroad programmes, exchange opportunities, and internships with partner institutions worldwide. These programmes enable students to experience different educational systems, cultures, and perspectives, enhancing their global competence and cross-cultural understanding. The university also welcomes international students, fostering a diverse and inclusive learning environment (www.unilorin.edu.ng).

The CIE has established strategic partnerships and collaborations with reputable institutions worldwide. These partnerships facilitate faculty and

student exchange, joint research initiatives, curriculum development, and capacity-building programs. Through these collaborations, Unilorin promotes knowledge transfer, cultural understanding, and the exchange of best practices, further enhancing the university's global impact. To facilitate internationalisation efforts, CIE provides comprehensive support services to students and faculty members. The university offers guidance on study abroad opportunities, assists with visa processes, and provides pre-departure orientations.

Collaborative Initiatives and Partnerships of the University of Ilorin with Other Universities across the Globe

The University of Ilorin, one of Nigeria's leading academic institutions, has established numerous collaborations and partnerships with universities across the globe. These collaborative efforts contribute to the university's mission of promoting academic excellence, research innovation, and global engagement. These collaborations span various areas, including student and faculty exchanges, joint research projects, curriculum development, and capacity building programmes. By engaging in these collaborative initiatives, the University strives to enhance its academic programmes, promote diversity, and foster a global mindset among its students and faculty.

One notable collaborative initiative is the establishment of partnerships for student mobility programmes. The University has developed agreements with universities in different countries, allowing students to study abroad for a semester or a whole academic year. These partnerships provide students with an opportunity to experience different educational systems, cultures, and perspectives, contributing to their personal and intellectual growth. In addition, the University actively engages in research collaborations with international partners. Through these partnerships, faculty members from different disciplines collaborate on joint research projects that address global challenges and contribute to the advancement of knowledge. These collaborations often result in publications, conferences, and innovative solutions that have a positive impact on society. The University also prioritises capacity building initiatives by partnering with international institutions to offer training programmes, workshops, and seminars. These programmes aim to enhance the skills and knowledge of faculty members and administrative staff, enabling them to deliver high-quality education and

services. Through these collaborations, the University strengthens its institutional capacity and promotes professional development within its community (www.unilorin.edu.ng).

Case Examples of Successful Collaborations of the University of Ilorin

The University of Ilorin has actively pursued collaborations and partnerships with various institutions both within Nigeria and internationally. These collaborations have resulted in successful initiatives and projects that have contributed to the academic and research excellence of the University. The table below highlights the current MoUs of the University with other Institutions across the globe:

S/N	UNVERSITIES (MOU)	DATE OF LAST SIGNATURE
1.	The University of Gambia	2017-2022
2.	Texas A&M University, USA	2015-2020
3.	George Washington University	2015-2020
4.	AWAU	2015 till date
5.	C&IR-Institute of Minerals Material Technology, Bhubaneswar, India	2015-2020
6.	University of Kelaniya, Sri-Lanka	Undated
7.	Birmingham City University	2015-2020
8.	University of Kansas, Florida	2015-2020
9.	The University of Georgia, Athens, United State of African Studies (ASI)	2015-2020
10.	The University of Florida	2017-2022
11.	Reinhardt University Waleska Georgia	2017-2022
12.	Indian Institute of Tech and Madras, Chennai, India	2017-2022
13.	Aalto University School of Electrical Engineering, Finland	2015-2020

14.	Kyungpook National University, South Korea	2018-2021
15.	Kenyyata University, Nairobi, Kenya	2012-2022
16.	University of Abomey calavi, (Benin)	2019-2024
17.	University of Ghana Legon	2019-2024
18.	Swansea University, UK	2019-2022
19.	Alabama A&M University	2014-2019
20.	University of Torino, Italy	2023-2028
21.	University of Salford UK	2013-2017
22.	University of Glasgow Scotland	2023-2028
23.	Uka Tarsadia University, Gujarat, Indian	2023-2028
24.	Albany University, USA	In progress
25.	University of Regina, Canada	Active
26.	Chavan Law College, Pune, India	In progress
27.	Kwazulu-Nata, South Africa	2015 – 2020
28.	International Islamic University, Malaysia (IIUM)	2010-2015
29.	Ex-culture	In progress
30.	Arden University, UK	In progress
31.	Catholique University, Cameroon	2010-2015
32.	University of Wisconsin-Madison, USA	Active
33.	UNIVERSITY OF Cape Coast, UCC Ghana	2013-2018
34.	Sasakawa	2010-2015
35.	Ain Shams	Undated MoU
36.	Cape Peninsula University of Technology, South Africa	2009-2014

37.	University of Pretoria, South Africa	In progress
38.	University of Lome, Togo	2023
39.	Robert Gordon University (RGU)	In progress
40.	Temple University, USA	In progress
41.	Mykolas Romeris University, Luthinian, Europe	Active
42.	Virginal University	2009-2014
43.	Islamic University of Madinah (IUM)	In progress
44.	The Scaling School	Active
45.	Blue Economy	2024
46.	Opolo	2024
47.	WARIMA	2024
48.	WARI	2024
49.	De Monfort University, Leicester, United Kingdom	2024
50.	U6+ Consortium and KU8+	2024

Through the collaboration with abovementioned institutions and organisations, Unilorin has had student exchange with Kenyata University, with about 8 students visiting Unilorin and 6 unilorin students visiting Kenyata University The exchange was on semester based whereby the students spent a semester in the host university and carried the scores obtained back to their home university. Presently, two of Unilorin Law students are in Torino on student exchange. A lecturer from the faculty of Law, Dr Azubike, has just returned from the same Torino University on staff Exchange.

Based on the MoU signed with Wisconsin on the 19th May, 2016, a Memorandum of Agreement tagged 'Visiting Scientist Training' was entered into on the 15th May 2022, between the Board of Regents of the University of Wisconsin System on behalf of the University of Wisconsin-Madison and the University of Ilorin. Based on this agreement, three lecturers from Unilorin

visited Wisconsin between July 1 2016 and June 30 2018 for the training on Stem Cell research. They are: Dr Ibrahim Adisa, Dr Abiola Samuel Babatunde and Dr Olufunke Esan Olorundare. This set of staff had since returned to Nigeria and assumed duty at Unilorin. They are engaging in the retraining of staff and coordinating the activities of Stem Cell in the University. Another agreement was entered into with the same University on October 15, 2022 to train another set of two faculties namely: Dr David Animasaun and Dr Saheed Afolabi. The training, which was scheduled to last for 18 months, took effect from October 15, 2022 and ended on June 30, 2024.

As part of the activities of the Collaboration with Uka Tarsadia University (UTU), more than 7 faculties of Unilorin visited India with two postgraduate students. Professor R. Krishnamurthy of UTU visited Unilorin more than six times. In addition to teaching and research, he helped Unilorin in breeding rice and bananas, which is of India origin.

Nikolas Romario University's collaboration with Unilorin yielded one postgraduate student, Mrs Adebimpe, one non-academic staff member, Mrs Gambari and one faculty visitor to the university on exchange with the sponsorship of ERASMUS.

Unilorin has joined different consortia to organise conferences such as CUSAC Consortium, the U6 consortium, AWAU, WARIMA, KU8 and others.

These case examples highlight the University of Ilorin's commitment to fostering collaborations and partnerships that contribute to academic excellence, research innovation, and societal impact. Through these successful collaborations, the University has strengthened its position as a leading institution in Nigeria and has made significant contributions to various fields of knowledge.

Benefits of Partnerships and Inter-University Linkages

Academic Excellence and Innovation

The University of Ilorin has established itself as a leading institution in academic excellence and innovation. With a commitment to providing quality education, fostering research, and promoting innovation, the University has consistently demonstrated its dedication to shaping the future of higher education in Nigeria and beyond. It has a long-standing reputation for

academic excellence. It is consistently ranked among the top universities in Nigeria and has received numerous accolades for its academic programs. According to the 2014 University Web Ranking conducted by 4 International Colleges and Universities (4ICU), UNILORIN ranked number 1 in Nigeria, 20th in Africa. The university's commitment to quality education is reflected in its rigorous admission process, highly qualified faculty members, and comprehensive curriculum. The university offers a wide range of undergraduate and postgraduate programmes across various disciplines, including sciences, arts, social sciences, engineering, and medical sciences (www.unilorin.edu.ng). These programmes are designed to meet national and international standards and provide students with a solid foundation in their chosen fields.

In addition to its strong academic programmes, the University of Ilorin provides a conducive learning environment with state-of-the-art facilities such as well-equipped laboratories, libraries, and research centers. The University also emphasises the use of technology in teaching and learning, integrating e-learning platforms and digital resources to enhance the educational experience. The University has a vibrant research culture and has made significant contributions to various fields of knowledge. Faculty members actively engage in research and have published numerous scholarly articles in reputable journals. The university encourages interdisciplinary research collaborations and provides support for faculty members to pursue research grants and projects.

The institution has also fostered a culture of innovation and entrepreneurship among its students. Various initiatives, such as the Technical and Entrepreneurship Centre (TEC), have been introduced to promote creativity, problem-solving, and business acumen (www.unilorin.edu.ng). These efforts aim to equip students with the necessary skills and mindset to thrive in a rapidly changing global economy. The University has established research centers and institutes to address societal challenges and contribute to national development. These centers focus on areas such as agriculture, health, renewable energy, and information technology. Through these research endeavors, the University aims to provide practical solutions to real-world problems and make a positive impact on society.

Unilorin International Research Networks

The University of Ilorin recognises the significance of international collaboration in fostering research excellence and innovation. To enhance global research engagement, the University has established Centre for International Education (CIE) that facilitates collaborations with renowned institutions and researchers worldwide. These networks serve as platforms for knowledge exchange, interdisciplinary research, and collaborative projects in various fields of study. The University International Centre brings together researchers, scholars, and experts from diverse backgrounds to collaborate on cutting-edge research topics. These networks aim to address global challenges, promote knowledge creation, and contribute to the advancement of scientific understanding. By connecting researchers across borders, the University fosters cross-cultural perspectives and encourages interdisciplinary collaboration.

The University of Ilorin spans a wide range of disciplines, including but not limited to science, technology, engineering, humanities, social sciences, and health sciences. Each network focuses on specific research areas, enabling scholars to share expertise, exchange ideas, and undertake collaborative research projects of mutual interest. Through the CIE, researchers at the University of Ilorin have opportunities to engage in joint research activities such as collaborative projects, co-publications, data sharing, and research exchange programs. These initiatives not only enhance the quality and impact of research conducted at the university but also contribute to global knowledge dissemination and academic recognition. The University actively seeks partnerships and collaborations with renowned international institutions and organisations to expand its research networks. These collaborations are facilitated through memoranda of understanding, research agreements, and joint funding initiatives. By leveraging the expertise and resources of its partners, the University aims to address complex research challenges and make meaningful contributions to society.

Furthermore, the establishment of the Centre for Research Development and In-house Training (CREDIT) at the University of Ilorin also provides opportunities for capacity building and professional development for researchers. They organise workshops, seminars, conferences, and training programs, both locally and internationally, to enhance research skills, promote

interdisciplinary collaboration, and foster networking among researchers. In 2021, two University of Ilorin dons, Prof. Joshua Olaoye and Dr Musliu Sunmonu, won a research grant of £233,780 from the Innovate UK African Agriculture Knowledge Transfer Partnership (KTP). (Mohammed-Lawal, 2021).

The former Director of the Centre Prof. Olugbenga Mokuolu, an expert in Paediatrics and Child Health, University of Ilorin (UNILORIN) won several grants on malaria. He has been elected Co-Chair of Roll Back Malaria (RBM) Partnership Case Management Working Group. (Mohammed-Lawal, 2024).

Unilorin Cultural Diversity and Global Perspective

University of Ilorin embraces and celebrates cultural diversity while fostering a global perspective among its students, faculty, and staff. Recognising the importance of a multicultural learning environment, the university promotes inclusivity, intercultural understanding, and global citizenship. The diverse student body at the University of Ilorin consists of students from various ethnic, religious, and cultural backgrounds. This diversity enriches the academic experience by exposing students to different perspectives, traditions, and worldviews. It creates a vibrant campus community where students can learn from one another, challenge stereotypes, and develop a greater appreciation for cultural differences.

The university actively promotes cultural diversity through various initiatives and activities. Orientation for newly admitted International students, International students' day celebration, and acculturation are organised to celebrate the traditions, languages, and customs of different cultures represented within the international community of the university. These events provide an opportunity for students to showcase their cultural heritage, learn about other cultures, and foster a sense of belonging and mutual respect. Furthermore, the University of Ilorin encourages internationalisation and global engagement through exchange programs, partnerships with international institutions, and collaborative research projects. These initiatives provide students and faculty members with opportunities to broaden their horizons, engage in cross-cultural interactions, and gain a global perspective.

The University also offers courses and programmes that emphasise global issues, intercultural communication, and international perspectives. By integrating global themes into the curriculum, the University of Ilorin prepares

students to be global citizens who are knowledgeable about global challenges, sensitive to cultural diversity, and capable of contributing to a more inclusive and interconnected world. In addition to academic endeavours, the University of Ilorin promotes cultural diversity through student organisations, clubs, and societies. These groups provide platforms for students to come together based on shared interests, cultural backgrounds, or international affiliations. They organise cultural events, discussions, and community service activities that promote intercultural dialogue, friendship, and cooperation. The University's commitment to cultural diversity and global perspective extends to its faculty and staff. The University of Ilorin encourages diversity in its recruitment practices, ensuring that the faculty and staff reflect a range of backgrounds and experiences. This diverse representation among the faculty and staff enhances the quality of education, research, and institutional decision-making, while fostering an inclusive and equitable environment for all.

Challenges and Strategies

Institutional Barriers

The University of Ilorin, like any other institution, faces various challenges related to institutional barriers that may hinder its effectiveness and hinder the achievement of its goals. These barriers can include bureaucratic processes, inadequate resources, hierarchical structures, and resistance to change. However, the University has implemented strategies to address these challenges and create a more conducive and progressive environment for all stakeholders. One of the primary challenges faced by the University of Ilorin is bureaucratic processes. These barriers can slow down decision-making, hinder innovation, and impede the effective implementation of policies and initiatives. To overcome these challenges, the University has taken steps to streamline administrative processes, enhance transparency, and improve communication channels between different departments and units. By simplifying procedures and promoting a culture of efficiency, the University aims to reduce bureaucratic barriers and foster a more agile and responsive institution. Inadequate resources pose another significant challenge for the University. Limited funding, outdated infrastructure, and insufficient equipment is hindering the quality of education, research, and overall institutional performance. To address this challenge, the University has focused on diversifying its sources of funding, seeking external grants and

partnerships, and engaging in fundraising activities. These efforts aim to secure additional resources to support academic programs, infrastructure development, and research initiatives. Additionally, the University has implemented prudent financial management practices to optimise resource allocation and ensure effective utilisation of available funds.

Hierarchical structures and rigid organisational cultures can also create institutional barriers within the University of Ilorin. These barriers can impede collaboration, hinder decision-making at lower levels, and limit opportunities for innovation and creativity. In response, the University has embraced a more participatory approach to decision-making and encouraged open communication across different levels of the institution. By fostering a culture of inclusivity and empowering staff and students, the University aims to break down hierarchical barriers and promote a sense of ownership and shared responsibility. (www.unilorin.edu.ng)

Resistance to change is another challenge that many institutions face, including the University of Ilorin. Change initiatives, such as the implementation of new policies regarding internationalisation drive, curriculum reforms, or technological advancements, can face resistance from various stakeholders. To address this challenge, the University has focused on creating awareness, providing training and capacity-building programs, and emphasising the benefits of change. By involving stakeholders in the decision-making process and addressing their concerns, the University aims to overcome resistance and create a more adaptable and progressive institution.

Cultural and Linguistic Differences

The University, as a diverse and inclusive institution, recognises and celebrates the cultural and linguistic differences among its students, faculty, and staff. It embraces the richness and diversity of its community, fostering an environment that promotes cultural understanding, respect, and inclusivity. It is also a home to a diverse student body, with students coming from various cultural backgrounds, ethnicities, and regions within Nigeria and around the world. These cultural differences contribute to a vibrant and enriching learning environment, where students have the opportunity to interact with peers from different traditions, customs, and perspectives. The University encourages cultural exchange through events, festivals, and cultural showcases that promote the sharing of traditions, arts, and cultural heritage.

Faculty and staff members at the University of Ilorin also bring diverse cultural experiences and perspectives to the institution. This diversity enriches the academic environment, enabling a wide range of knowledge and ideas to be shared within classrooms, research projects, and academic discussions. The university values the contributions of its diverse faculty and staff, recognising that cultural differences can lead to new insights, innovative approaches, and interdisciplinary collaborations. The university acknowledges the importance of linguistic diversity and strives to create an inclusive environment where all languages are respected. English is the official language of instruction and communication at the University of Ilorin. However, the institution recognises the need for multilingualism and offers support services to improve English language proficiency for students whose first language is not English, thereby establishing Linguistic Immersion Centre (LIC) to immerse students from francophone countries. Additionally, efforts are made to preserve and promote Nigerian languages through cultural events, language clubs, and initiatives that celebrate linguistic diversity. The University of Ilorin is committed to ensuring that cultural and linguistic differences are respected and embraced across all aspects of campus life. By fostering an inclusive environment, the university encourages cross-cultural interactions, promotes cultural sensitivity, and provides opportunities for students and faculty to learn from one another. (www.unilorin.edu.ng)

Strategies Employed by Unilorin to Overcome Challenges

The University of Ilorin has faced various challenges throughout its history, but it has consistently employed effective strategies to overcome these obstacles and maintain its commitment to academic excellence and institutional growth. By implementing proactive measures and adopting innovative approaches, the university has successfully navigated challenges and continued to thrive in the face of adversity.

Strategic Planning: The University of Ilorin places great emphasis on strategic planning to anticipate and address challenges effectively. The institution engages in comprehensive long-term planning, setting clear goals and objectives aligned with its vision. Through strategic planning, the university identifies potential challenges, formulates action plans, and allocates resources strategically to overcome obstacles and achieve its desired outcomes.

Research and Innovation: The University recognises the importance of research and innovation in addressing challenges and driving institutional growth. It encourages faculty and students to engage in cutting-edge research, fostering a culture of innovation and problem-solving. By promoting research-driven solutions, the University of Ilorin tackles challenges in various fields, contributing to knowledge creation and societal development.

Collaboration and Partnerships: The University of Ilorin actively seeks collaborations and partnerships with other academic institutions, industry partners, and government agencies. By forging strategic alliances, the university gains access to additional expertise, resources, and funding opportunities. Collaborative efforts enable the institution to tackle complex challenges collectively, leveraging collective knowledge and experience.

Capacity Building and Professional Development: The University invests in capacity building and professional development programs for faculty, staff, and students. By enhancing their skills and knowledge, individuals are better equipped to overcome challenges and adapt to changing circumstances. The University of Ilorin offers training programs, workshops, and seminars to enhance technical, managerial, and leadership capabilities, fostering a culture of continuous learning and growth.

Student Support Services: Recognising the importance of student success, the university provides comprehensive support services to students facing challenges. These services include counselling, academic advising, mentoring programs, and career guidance. By addressing students' personal and academic needs, the university ensures that they have the necessary support to overcome challenges and thrive in their educational journey.

I**nfrastructure Development:** The University of Ilorin invests in the development of modern infrastructure and facilities to meet the evolving needs of its academic community. Upgrading and expanding infrastructure enhances the teaching, learning, and research environment, enabling the institution to overcome challenges related to limited resources and outdated facilities.

Continuous Quality Improvement: The University emphasises a culture of continuous quality improvement, regularly assessing its programs, processes, and services to identify areas for enhancement. By soliciting feedback from stakeholders and benchmarking against international standards, the institution

identifies challenges and implements measures to address them effectively, ensuring the delivery of high-quality education and services. (www.unilorin.edu.ng)

Conclusion and Recommendations

Partnerships and inter-university linkages serve as strategic tools for the internationalisation of universities, as demonstrated in this study of Unilorin. The university's commitment to fostering collaborations and establishing partnerships with institutions globally has played a significant role in enhancing its international presence, promoting academic excellence, and providing enriching opportunities for students and faculty members. Through its partnerships and inter-university linkages, Unilorin has gained access to a wide range of resources, expertise, and diverse perspectives that have enriched its academic programs and research endeavours. Collaborative initiatives have allowed for the exchange of knowledge, research collaborations, joint publications, and joint projects, contributing to the advancement of scientific understanding and addressing global challenges.

Furthermore, partnerships and inter-university linkages have facilitated student and faculty mobility programs, enabling the University of Ilorin community to engage in international experiences. Students have had the opportunity to study abroad, participate in exchange programs, and gain exposure to different cultures and academic environments. Faculty members have benefited from research visits, conferences, and collaborative projects, enhancing their professional development and contributing to the university's research output.

Recommendations:

Based on this study of Unilorin, the following recommendations can be made to further strengthen and leverage partnerships and inter-university linkages for the internationalisation of universities:

a- **Expand and Diversify Partnerships:** Unilorin should continue to actively seek and establish partnerships with diverse institutions worldwide. Strengthening existing partnerships and exploring new collaborations will provide opportunities for faculty and students to engage in a broader range of international experiences and research collaborations.

b- **Strategic Focus:** The University should strategically identify key areas of focus for partnerships and linkages that align with its academic strengths and research priorities. By targeting specific disciplines or thematic areas, Unilorin can maximise the impact of its collaborations and enhance its global reputation in those fields.

c- **Enhance Support Services:** The University should provide comprehensive support services for students and faculty members engaged in international partnerships and inter-university linkages. This includes assistance with visa processes, funding opportunities, cultural orientation, and logistical support, ensuring a smooth and successful experience for all participants.

d- **Establish Joint Degree Programs**: Unilorin should explore the establishment of joint degree programs with partner institutions. Joint degree programs offer students the opportunity to earn a degree from both institutions, providing them with a truly international educational experience and enhancing their employability in the global job market.

e- **Foster Research Networks:** The University should encourage the formation of research networks and consortia with partner institutions. These networks can facilitate collaborative research projects, joint funding applications, and knowledge sharing, strengthening the research capabilities of Unilorin and its partners.

f- **Promote Faculty Development:** Unilorin should invest in faculty development programs that equip faculty members with the skills and competencies necessary for effective international collaborations. This includes providing training on intercultural communication, grant writing, project management, and research collaboration.

In conclusion, partnerships and inter-university linkages are strategic tools for the internationalisation of universities, as demonstrated by the case study of the University of Ilorin. By expanding and diversifying partnerships, focusing on strategic areas, enhancing support services, establishing joint degree programs, fostering research networks, and promoting faculty development, Unilorin can further leverage these tools to enhance its international presence and academic excellence.

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CHAPTER SEVEN

Assessment of Neurochemical and Biochemical Safety of Levonorgestrel in Female Wistar Rats: Implications for Quality Assurance in Contraceptive Use and Supplement Co-administration

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Abstract

This study investigated the neurobiological effects of levonorgestrel (LNG), a widely used contraceptive medication, and the potential modulatory role of melatonin, a readily available supplement. Using a female Wistar rat model, the research examined the effects of varying dosages and exposure frequencies of LNG, alone and in combination with melatonin, on neuro-oxidative stress, lipid profiles, and bioenergetics. The findings of this study have significant implications for global health and well-being, particularly in ensuring medication safety and promoting sustainable health practices. The research contributed to a broader understanding of pharmaceutical impacts on diverse populations worldwide, addressing challenges in quality assurance and safe medication use. The study's results can inform educational initiatives regarding responsible medication use and supplement co-administration, ultimately promoting public health and well-being.

Keywords: Levonorgestrel, Melatonin, Neurobiology, Global Health.

Introduction

Levonorgestrel (LNG), a synthetic progestogen, is widely used in emergency contraceptive pills (ECPs) and hormonal contraceptives (Glasier et al., 2011). While its efficacy in preventing unintended pregnancies is well-established, concerns regarding its potential neurochemical and biochemical effects have emerged (Kallner and Danielsson, 2016). Understanding these effects is crucial for ensuring the safety and quality assurance of contraceptive use,

particularly in the light of the global prevalence of hormonal contraceptive usage (Rudzinski et al., 2023; UNPD, 2018). Furthermore, the co-administration of supplements like melatonin (MLT) with LNG warrants investigation to determine potential modulatory effects and ensure the safety of combined usage.

Neurochemical assessments are essential to evaluate the impact of LNG on brain function, as hormonal fluctuations can influence neurotransmitter systems and neuronal integrity (McEwen, 2012). Biochemical parameters, including lipid profiles and oxidative stress markers, provide insights into systemic effects and potential adverse outcomes. Disruptions in these parameters may indicate increased cardiovascular risk or compromised cellular function. This study aimed to assess the neurochemical and biochemical safety of LNG in female Wistar rats, simulating human dosages and frequencies of exposure. By evaluating various endpoints, including brain and serum lipid profiles, oxidative stress markers, and enzyme activities, the study sought to elucidate the potential risks associated with LNG use and the protective role of MLT co-administration. The findings would have significant implications for quality assurance in contraceptive use and supplement co-administration, informing clinical practice and public health guidelines.

Materials and Methods

Experimental Animals

Forty (40) mature female Wistar rats (average 200g) were used. They were housed under controlled conditions (temperature, humidity, light cycle). The animals were acclimatised for 15 days and had free access to food and water. All procedures were approved by the University of Ilorin Animal Care Committee and followed NIH guidelines.

Treatments

Levonorgestrel (LNG) was dissolved in 0.9% saline to simulate human doses in rats (4 μg/kg and 8 μg/kg). Melatonin was also dissolved in 0.9% saline (10mg/kg).

Experimental Design

The study looked at the effects of regular (once weekly) and frequent (three times weekly) LNG exposure at recommended dose (simulation, 4 µg/kg) and misused high dose (8 µg/kg) respectively. Rats were divided into five (5) main groups: control, low-dose LNG, high-dose LNG, low-dose LNG + melatonin, and high-dose LNG + melatonin. Each group was further divided into regular exposure (RE, once weekly) and frequent exposure (FE, three times weekly). Treatments were administered orally via gavage for eight weeks.

Sample Collection

Animals were euthanised, and blood samples were collected for serum analysis. Brain tissues were collected and homogenised for neurochemical analysis.

Biochemical Parameters

Lipid profiles (total cholesterol, triglycerides, HDL-C, LDL-C, VLDL-C, non-HDL-C, AIR, CRR) were measured. Very low density lipoproteins-cholesterol (VLDL-C) was assessed as one-fifth of TG and low density lipoproteins-cholesterol (LDL-C) was estimated using Friedewald's formula: [LDL-C= TC – (HDL-C + VLDL) mg/g (Friedewald et al., 1972). Also, Non-HDL-C was calculated by estimating the differences between total cholesterol and high densit lipoprotein cholesterol [Non-HDL-C=TC-HDL-C]. The Atherogenic Index Risk (AIR) was evaluated by: Log (TG/HDL-C) and Cardiovascular Risk Ratios (CRR) by: CRRI= TC/HDL-C ratio; CRRII= LDL-C/HDL-C ratio (Dobiasova, 2004).

Lipid peroxidation (MDA) and nitric oxide (NO) levels were determined. Antioxidant enzyme activities (SOD, GPx, CAT, GSH, G6PDH) were measured.

Data Analysis

GraphPad Prism 8.0 was used for statistical analysis. Data were presented as mean ± SEM. One-way ANOVA followed by Tukey's post hoc test was used to determine statistical significance at $p < 0.05$.

Results and interpretations

The available data analysis were presented in tables 1-3.These tables present the effects of Levonorgestrel (LNG) and Melatonin (MLT) on various

biochemical parameters in the brain and serum of female Wistar rats, with varying frequencies of LNG exposure (once or thrice weekly). The significance of these findings relates to the potential neurotoxicity of LNG and the protective role of MLT, which has implications for understanding the impact of pharmaceuticals on biological systems. In the context of globalised education, this type of research is crucial for ensuring quality assurance in scientific methodologies and the ethical use of experimental models.

Effect of LNG and/or MLT on brain Cholesterol and Lipoproteins:

In the brain, high-dose LNG administered once weekly significantly decreased total cholesterol and LDL levels compared to the control group (Table 1). This suggests a potential disruption of lipid metabolism within the central nervous system. Equally, frequent LNG exposure (thrice weekly) led to increased total cholesterol and LDL levels, highlighting the dosage-dependent effects of LNG on brain lipid profiles. Melatonin co-administration generally attenuated the adverse effects of LNG, particularly at the higher dose, suggesting a protective role against LNG-induced lipid dysregulation. This is important, because changes to lipid profiles within the brain, can profoundly affect neurological function (Alghamdi, 2018; Reiter et al., 2016).

Cardiovascular Risk Ratios (CRR) and Atherogenic Coefficient (AC):

The CRR I, CRR II and AC indices, which reflect cardiovascular risk, were significantly reduced in the LNG plus MLT groups (once weekly). This implies that melatonin exhibited a protective effect against potential cardiovascular complications induced by LNG (Table 1). Frequent LNG exposure, however, increased these risk ratios, suggesting a heightened cardiovascular risk with increased LNG frequency. These results provide important information relating to the systemic effects of LNG, and the potential protective properties of MLT (Table 1).

Implications for Assessment and Quality Assurance:

These findings emphasised the importance of rigorous assessment and quality assurance in pharmaceutical research, particularly when investigating potential neurotoxic effects and systemic impacts of drugs. The inclusion of multiple parameters and statistical analysis (ANOVA, Tukey's post hoc) ensured the reliability and validity of the results, aligning with best practices in scientific research.

Table 1: Effects of Levonorgestrel and Melatonin on lipid profiles and indices in the brain of female Wistar rats

Treatments /Parameters	NS 1 ml/kg	LNG 4 µg/kg	LNG 8 µg/kg	LNG 4 µg/kg /MLT 10 mg	LNG 8 µg/kg /MLT 10 mg
Brain Total Cholesterol mg/dL					
Once /week	405.12±17.85	421.44±18.33	313.68±11.96*	241.23±13.37*	310.59±1.54*
Thrice/week	197.30±17.42	235.84±15.39	296.72±13.70#	322.16±8.16#	379.86±15.52#
Brain Triacylglyceride mg/dL					
Once /week	324.26±4.14	295.27±8.22*	283.78±10.60*	246.15±2.13*	265.68±12.98*
Thrice/week	235.51±4.61	258.70±8.45*	308.88±8.13*	291.71±4.84*	310.99±5.89*
Brain very low density lipoproteins (VLDL) mg/dL					
Once /week	64.85±0.83	59.05±1.64*	56.76±2.12*	49.23±0.43*	53.14±2.59*
Thrice/week	47.10±0.92	51.74±1.69*	61.78±1.63*	58.34±0.97*	62.19±1.18*
Brain high density lipoprotein (HDL) mg/dL					
Once /week	30.37±2.83	29.54±1.25	27.24±2.71	27.15±2.01	32.30±0.83
Thrice/week	24.02±2.63	25.77±1.81	28.07±1.53	28.89±1.99	29.08±2.17
Brain low density lipoprotein (LDL) mg/dL					
Once /week	309.89±15.23	332.84±15.60	229.68±13.28*	164.85±14.85*	225.16±3.18*
Thrice/week	126.18±14.28	158.33±16.89	206.88±13.98*	234.91±9.88*	288.58±13.18*
Brain non-HDL mg/dL					
Once /week	374.75±15.97	391.89±17.21	286.44±13.00*	214.08±15.26*	278.29±0.71*
Thrice/week	173.28±15.20	210.07±17.01	268.65±14.00*	293.26±8.96*	350.78±14.34*
Cardiovascular risk ratio l (CRR I)					
Once /week	13.51±1.04	14.27±0.28	11.75±1.24	9.06±1.20*	9.63±0.20*
Thrice/week	8.27±0.49	9.31±1.14	10.64±0.85	11.26±0.87*	13.15±0.76*
Cardiovascular risk ratio ll (CRR II)					
Once /week	10.34±0.85	11.27±0.24	8.64±1.11	6.22±1.05*	6.97±0.11*
Thrice/week	5.27±0.39	6.27±0.99	7.42±0.72	8.23±0.78*	9.99±0.64*

Atherogenic coefficient (AC)					
Once /week	12.51±1.04	13.27±0.28	10.75±1.24	8.06±1.21*	8.63±0.20*
Thrice/week	7.27±0.49	8.31±1.14	9.64±0.85	10.26±0.87*	12.15±0.76*

*Data were expressed as mean ±SEM; once per week (RE-regular exposure) *P<0.05 vs. NS (control group) and thrice per week (FE-frequent exposure) #P<0.05 vs. NS (control group)*

Effect of LNG and/or MLT on serum lipid profiles and cardiovascular risk

Levonorgestrel (LNG) treatment, especially at 4 µg/kg, consistently lowered total cholesterol, triacylglycerides, VLDL, LDL, and non-HDL levels compared to the control (NS). LNG, particularly at 4ug/kg once a week, and 8ug/kg thrice a week, resulted in elevated HDL levels. The combination of LNG and melatonin generally showed a further improvement in lipid profiles, suggesting a synergistic effect. LNG and LNG+MLT treatments significantly reduced cardiovascular risk ratios (CRR I and CRR II) and the atherogenic coefficient (AC), indicating a lower risk of cardiovascular disease.

The frequency of administration (once vs. thrice weekly) influenced the magnitude of the effects, with some variations observed between the two schedules. These changes in serum lipid profiles may reflect systemic effects of LNG, impacting lipid metabolism beyond the brain. The use of serum lipid levels is a common practice when assessing the overall health of the test subject (Table 2).

Table 2: Effects of Levonorgestrel and Melatonin on lipid profiles and indices in the serum of female Wistar rats

Treatments/ Parameters	NS 1 ml/kg	LNG 4 µg/kg	LNG 8 µg/kg	LNG 4 µg/kg /MLT 10 mg	LNG 8 µg/kg /MLT 10 mg
Serum Total Cholesterol					
Once /week	220.42±5.05	176.49±8.58*	207.32±22.39	200.39±10.71	184.20±2.78
Thrice/week	219.65±18.49	170.32±5.05 #	185.74±12.11	185.74±13.50	191.99±3.14
Serum triacylglyceride					
Once /week	217.75±9.52	160.95±11.24*	200.59±15.51	185.21±16.34	165.09±5.12*

Thrice/week	219.53±23.76	154.44±5.71*	161.54±9.78*	158.58±8.71*	156.22±5.12*
Very low density lipoproteins (VLDL)					
Once /week	43.55±1.90	32.19±2.25*	40.12±3.10	37.04±3.27	33.02±1.02*
Thrice/week	43.91±4.75	30.89±1.14*	32.31±1.96*	31.72±1.74*	31.25±1.02*
High density lipoprotein HDL					
Once /week	38.47±1.93	53.01±5.89*	33.50±3.13	40.31±3.92	47.31±2.18
Thrice/week	40.49±3.93	41.32±3.95	52.46±2.77*	55.49±4.25*	45.39±1.76
Low density lipoprotein (LDL)					
Once /week	138.40±2.94	91.29±8.91*	133.70±21.32	123.03±10.82	103.88±4.27
Thrice/week	135.25±17.90	98.11±6.69*	100.97±10.43	98.53±13.95	115.36±3.87
Serum Non-HDL					
Once /week	181.95±4.27	123.48±11.14*	173.82±24.13	160.07±14.09	136.89±4.66*
Thrice/week	179.16±22.29	129.00±7.79*	133.28±12.33*	130.24±15.47*	146.60±4.89
Cardiovascular risk ratio l (CRR I)					
Once /week	5.75±0.23	3.42±0.48*	6.34±1.05	5.12±0.81	3.91±0.22
Thrice/week	5.60±0.92	4.20±0.43	3.56±0.31*	3.39±0.39*	4.25±0.23
Cardiovascular risk ratio ll (CRR II)					
Once /week	3.61±0.19	1.79±0.36*	4.13±0.89	3.17±0.62	2.21±0.18
Thrice/week	3.45±0.71	2.44±0.35	1.94±0.25*	1.82±0.33*	2.56±0.18
Atherogenic coefficient (AC)					
Once /week	4.75±0.23	2.42±0.48*	5.35±1.05	4.12±0.81	2.91±0.22
Thrice/week	4.60±0.92	3.20±0.43	2.56±0.31*	2.39±0.39*	3.25±0.23

Data were expressed as mean ±SEM; once per week (RE-regular exposure)
**P<0.05 vs. NS (control group) and thrice per week(FE-frequent exposure)*
#P<0.05 vs. NS (control group)

Effects of Levonorgestrel and Melatonin on redox status and bioenergetics in the brain of female Wistar rats

Frequent LNG and /or Melatonin exposure (FE) improves energy metabolism by activating the AST and LDH activities but co-administered LNG/MLT at RE decreases LDH activity when compared to control (Table 3).

Levonorgestrel (LNG) and /or Melatonin effects on oxidative stress markers

Levonorgestrel (LNG), used in hormonal contraceptives, may have neurobiological effects. This parameter explored the impact of LNG on brain enzyme activities and oxidative stress markers (Song et al., 2023). The result shows that LNG, especially when administered thrice weekly, significantly increases aspartate transferase (AST) and lactate dehydrogenase (LDH) levels. This suggests potential cellular damage or altered metabolic activity in the brain (Zhang et al., 2016). The effects of LNG on oxidative stress markers; malondialdehyde MDA, and nitric oxide (NO) and antioxidant enzymes; superoxide dismutase (SOD), glutathione peroxidase (GPx), Catalase (CAT) are variable and depend on the dosage and frequency of administration.

Malondialdehyde MDA is a marker of lipid peroxidation, indicating oxidative damage. The data shows that LNG, in some combinations with MLT, reduces MDA levels, suggesting a potential antioxidant effect of the combined treatment. Nitric oxide NO plays a complex role in the brain. LNG significantly reduced NO levels when administered once a week. This implies that the NO-signaling related pathway may be disrupted. SOD, GPx, and catalase are antioxidant enzymes. Their activities reflect the brain's ability to combat oxidative stress. The results are varied, showing both increases and decreases depending on the treatment (Rummel and Butterfield, 2022).

Melatonin, a neuroprotective hormone, is often used to counteract oxidative stress (Tarocco et al., 2019). The combination of LNG and MLT appears to modulate the effects of LNG. In some cases, MLT seems to mitigate the adverse effects of LNG, particularly on LDH and MDA levels (Hardeland, 2018). However, the results are complex and needs more research to understand the full interaction of these two substances.

Levonorgestrel (LNG) and /or Melatonin effects on LDH, AST, AChE and G6PDH activities for neuronal membrane integrity

Aspartate transferase (AST) and lactate dehydrogenase (LDH) are indicators of cellular damage. Elevated levels suggest potential neurotoxicity. These enzymes also serve as bioenergetics marker for neuronal metabolic function. AChE is involved in neurotransmission. Changes in AChE activity can affect cognitive function. The result shows that some treatments increased AChE activity. Alteration in the Ach/AChE ratio (acetylcholine/cholinesterase ratio) may influence cholinergic-like discharge and cognitive outflow. G6PDH is an enzyme in the pentose phosphate pathway, crucial for producing NADPH, which is essential for antioxidant defense, in the iodination of thyroglobulin during the synthesis of thyroid hormones and reductive biosynthesis like steroids. The results of this measurement are very varied. This may be attributable to frequency of administration**;** thrice-weekly administration generally leads to more pronounced changes in enzyme activities and oxidative stress markers.

Potential Implications:

This study revealed the interaction between levonorgestrel and/or melatonin supplement (LNG/MLT) in the brain of female animal model. Here, the generated dataset suggested that LNG may have neurobiological effects, and MLT can modulate these effects. The findings highlighted the importance of considering the frequency and dosage of LNG administration.

Further research is needed to elucidate the underlying mechanisms and clinical implications of these findings.

Table 3: Effects of Levonorgestrel and Melatonin on redox status and bioenergetics in the brain of female Wistar rats

Treatments /Parameters	NS 0.3 ml	LNG 4 µg/kg	LNG 8 µg/kg	LNG 4 µg/kg /MLT 10 mg	LNG 8 µg/kg /MLT 10 mg
Brain Aspartate Transferase (AST) U/L					
Once /week	35.38±1.29	41.26±4.92	38.71±3.69	41.97±0.91	43.67±3.14
Thrice/week	15.52±2.14	41.48±3.55*	43.74±4.97*	41.26±2.56*	46.72±1.73*
Brain Lactate dehydrogenase (LDH) U/L					

Once /week	1537.58±30.73	1468.22±16.69	1498.02±17.75	1365.78±61.55*	1333.51±62.11*
Thrice/week	191.59±5.97	1432.42±18.77*	1518.31±8.68*	1434.04±36.54*	1400.15±33.48*
Brain Malondialdehyde MDA µM					
Once /week	1.03±0.07	0.98±0.08	1.23±0.29	0.72±0.02	0.52±0.01*
Thrice/week	0.88±0.18	0.81±0.18	1.03±0.11	0.62±0.06	0.55±0.09
Brain Nitric oxide (NO) µM					
Once /week	16.59±1.70	10.54±0.51*	10.34±2.04*	7.30±0.95*	7.43±1.08*
Thrice/week	5.15±1.19	5.19±0.61	8.70±1.88	8.57±1.18	8.54±1.36
Brain SOD activity µ/ml					
Once /week	0.66±0.11	0.60±0.09	0.78±0.19	0.81±0.18	0.56±0.06
Thrice/week	0.53±0.10	0.91±0.39	0.56±0.07	0.65±0.07	0.55±0.09
Brain GPx activity U/L					
Once /week	27.34±3.37	18.55±1.50	15.38±3.00	15.00±1.50	21.00±8.65
Thrice/week	10.88±0.99	21.76±5.45	31.13±4.88*	24.38±7.61	14.25±0.99
Brain Catalase activity U/mg protein					
Once /week	17.62±3.59	15.89±3.65	14.62±2.73	21.69±1.79	24.10±3.45
Thrice/week	16.63±2.22	14.59±0.75	17.42±1.44	24.94±4.01	17.29±3.68
Brain GSH U/L					
Once /week	1.77±0.21	1.72±0.17	1.58±0.03	1.41±0.05	1.44±0.04
Thrice/week	1.73±0.16	1.69±0.09	1.75±0.25	1.62±0.35	1.56±0.43
Brain G6PDH U/L					
Once /week	42.84±14.24	6.59±1.47*	23.13±4.20	26.65±4.20	25.52±5.46
Thrice/week	9.00±3.72	12.61±4.78	26.85±17.23	42.64±10.96*	15.97±2.44
Brain AChE µmol					
Once /week	0.08±0.00	0.06±0.00	0.07±0.01	0.07±0.01	0.07±0.00
Thrice/week	0.04±0.00	0.06±0.00	0.06±0.01	0.07±0.01*	0.07±0.00*

*Data were expressed as mean ±SEM; once per week (RE-regular exposure) *P<0.05 vs. NS (control group) and thrice per week (FE-frequent exposure) #P<0.05 vs. NS (control group)*

Discussion

The present study investigated the neurochemical and biochemical effects of levonorgestrel (LNG) administration in female Wistar rats, with a focus on assessing potential adverse outcomes and the modulatory role of melatonin (MLT). The data revealed significant alterations in lipid profiles, oxidative stress markers, and enzyme activities, highlighting the importance of thorough safety assessments in contraceptive use. In the brain, high-dose LNG administered once weekly significantly decreased total cholesterol and LDL levels, while frequent exposure increased these parameters. This suggests that LNG's impact on brain lipid metabolism is dose-and frequency-dependent. The observed changes in lipid profiles may reflect disruptions in cholesterol homeostasis, which is crucial for neuronal function and membrane integrity (Yang et al., 2022; Pfrieger, 2003).

Serum lipid profiles also showed significant alterations, with LNG administration leading to decreased total cholesterol and triacylglyceride levels but increased HDL levels (Pfrieger, 2003). These systemic effects may indicate that LNG influences lipid metabolism beyond the central nervous system. The cardiovascular risk ratios (CRR) and atherogenic coefficient (AC) were significantly reduced in the LNG-MLT co-administrated groups, suggesting a protective role of melatonin against potential cardiovascular complications. Given that cardiovascular health is a major concern globally, this is an important finding.

These findings underscore the importance of lipid profile monitoring in individuals using LNG-based contraceptives, particularly those with pre-existing cardiovascular risk factors. The protective effects of MLT highlight the potential benefits of supplement co-administration in mitigating adverse lipid-related effects. Frequent LNG exposure significantly increased aspartate transferase (AST) and lactate dehydrogenase (LDH) levels in the brain, indicating potential neurotoxicity. These enzymes are markers of cellular damage, suggesting that LNG may compromise neuronal integrity (He et al., 2023).

Oxidative stress, as indicated by malondialdehyde (MDA) levels, was significantly reduced by MLT co-administration, demonstrating its antioxidant properties. LNG administration also reduced nitric oxide (NO) levels, which may have implications for neurotransmission and neuronal signaling. The observed changes in enzyme activities, such as G6PDH and AChE, further highlighted the potential neurochemical effects of LNG. These findings necessitate careful consideration of LNG's neurotoxic potential and the protective role of antioxidants like MLT. Comprehensive neurochemical assessments are crucial for ensuring the safety of contraceptive use, particularly in individuals with neurological vulnerabilities.

Quality Assurance in Contraceptive Use and Supplement Co-administration

The present study highlighted the importance of rigorous assessment and quality assurance in contraceptive use and supplement co-administration. The observed alterations in lipid profiles, oxidative stress markers, and enzyme activities, underscored the need for thorough safety evaluations.

Standardization of Assessment Protocols: The use of validated methods for biochemical and neurochemical assessments ensured the reliability and comparability of results. Standardised protocols are crucial for global research collaborations and evidence-based decision-making (Bolarinwa, 2015; OECD, 2005).

Ethical Considerations: The use of animal models necessitated dherence to ethical guidelines, ensuring humane treatment and responsible research practices. Ethical considerations are paramount in global research collaborations and knowledge dissemination

Supplement Co-administration: The protective effects of MLT highlighted the potential benefits of supplement co-administration in mitigating adverse effects. However, further research is needed to determine optimal dosages and long-term effects.

Clinical Implications: The findings of this study have significant implications for clinical practice and public health guidelines. Healthcare providers should be aware of the potential neurochemical and biochemical effects of LNG and consider individualized risk assessments.

Limitations and Future Directions

The interpretation of these results was subject to certain limitations, including the utilisation of an animal model that may not entirely recapitulate human physiological responses. Subsequent research should prioritise the evaluation of the long-term effects of concurrent LNG and MLT administration, as well as their impact on reproductive function and behavioural endpoints. Clinical trials in human subjects are warranted to validate these preclinical observations.

Globalizing Education and Research Standards

These findings highlighted the need for standardised assessment protocols in global research, ensuring consistency and comparability of results across different laboratories and regions (OECD, 2005).

Conclusion

The present study provided valuable insights into the neurochemical and biochemical safety of LNG in female Wistar rats. The findings highlighted, the potential adverse effects of LNG and the protective role of MLT co-administration. Rigorous assessment and quality assurance are crucial for ensuring the safety of contraceptive use and supplement co-administration. Future research should focus on validating these findings in human populations and developing evidence-based guidelines for clinical practice.

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Conflict of Interest

Authors have declared that no potential conflicts of interest exist.

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CHAPTER EIGHT

EdTech and Digital Equity: Strategies for Advancing Accessible, Affordable, and Sustainable Global Learning

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Abstract

This study investigated the role of educational technology (EdTech) in advancing digital equity by ensuring accessible, affordable, resilient, and sustainable global learning opportunities. Drawing on secondary data from a range of published sources, the research identified critical barriers to equitable EdTech adoption, particularly in rural and underserved regions. The study identified key challenges mitigating the were critical barriers to equitable EdTech adoption included inadequate internet connectivity, unreliable electricity, high costs, and limited digital literacy. These factors disproportionately affected learners from marginalised communities, hindering their access to quality education. The findings underscored the urgent need for collaborative efforts among stakeholders to develop and implement inclusive, AI-driven EdTech solutions that are both cost-effective and contextually relevant. Promoting digital equity requires not only technological innovation but also policy support, infrastructure development, and capacity building. This study advocates for a strategic, multi-stakeholder approach to harness EdTech's full potential in delivering equitable and sustainable education, especially for Generation Alpha and Generation Beta learners across diverse global contexts

Keywords: Digital Equity, EdTech, Education, Global Learning, Sustainable

Introduction

The convergence of education and technology, commonly framed as EdTech, has accelerated unprecedented transformations in the global learning landscape. While digital tools promise democratised access to quality education, a pressing dilemma continues to persist—digital equity**.** This refers not only to equitable access to technology, but also the capacity to meaningfully use it. In theory, the global shift toward online and hybrid

education should signify progress. In practice, it risks deepening existing educational disparities, especially in socio-economically marginalized communities.

The urgency of this issue became particularly apparent during the COVID-19 pandemic, which acted as a catalyst for digital learning adoption but simultaneously exposed stark infrastructural, economic, and pedagogical divides. As Hodges et al. (2020) emphasised, the global move to emergency remote teaching was not a testament to EdTech's readiness, but rather a reactive necessity. Indeed, the digital learning gap was laid bare, particularly in the Global South, where millions of students were left behind due to lack of internet, devices, and digital competence.

Recent scholarly inquiries have offered valuable insights into this inequality. Bulman and Fairlie (2021), analyzing educational access during the pandemic, argued that even in high-income nations, low-income students disproportionately suffered learning losses due to digital disadvantages. In contrast, countries with robust EdTech infrastructures, such as Finland or South Korea, maintained some degree of continuity (Kim & Rose, 2020). Yet, this disparity underscores a more fundamental question—are we mistaking digital availability for digital accessibility? To unpack this, one must confront the hidden architecture of digital learning: not just hardware or bandwidth, but pedagogy, local context, affordability, and sustainability. Selwyn (2021) cautioned against the techno-solutionist narrative that assumes technology inherently solves educational problems. Rather, he insisted that EdTech needs to be grounded in social realities and educational justice. Without such grounding, the promise of EdTech as a global equaliser remains an illusion.

Furthermore, the intersection of EdTech and policy frameworks remains under-explored. Warschauer and Matuchniak (2010) called attention to "second-level digital divides," focusing not on access but on how students engage with technology. Their work suggested that even when devices are available, inequities in teacher preparedness, content design, and institutional support can perpetuate inequality. In a similar vein, van Dijk (2020) argued that digital access without accompanying social support mechanisms does little to challenge educational stratification.

This study critically examined how EdTech can effectively function as a catalyst for promoting digital equity by ensuring universal access,

affordability, resilience, and sustainability in global education systems. It aimed to explore the extent to which educational technologies can transcend infrastructural limitations and foster inclusive learning environments across diverse socio-economic and geographic contexts. The investigation also delved into the broader sociotechnical ecosystems—including policies, pedagogical practices, and digital literacy frameworks—that shape the equitable implementation of EdTech solutions. Furthermore, the study interrogated potential strategic pathways, such as AI-driven interventions and stakeholder collaborations across public, private, and community sectors, that can support scalable and context-sensitive EdTech deployment without sacrificing quality or equity. Ultimately, this research aspired to identify actionable strategies for advancing cost-effective and resilient educational models that serve both current and future generations globally. Grounded in secondary data from Indian academia—a diverse educational ecosystem that captures both the promise and pitfalls of digital learning, this study explored a multi-scalar view of EdTech: from national policy down to village classrooms. India serves as a microcosm of global digital education challenges. Its demographic dividend, linguistic heterogeneity, and rural-urban digital divide present a fertile terrain for examining both failures and future pathways.

The concept of sustainability also takes center stage in this inquiry. Too often, EdTech interventions are measured by their novelty rather than longevity. Al-Azawei, Serenelli, and Lundqvist (2016) highlighted that sustainable e-learning systems must align with user needs, technological ecosystems, and pedagogical goals. Sustainability is not simply about enduring platforms; it is about adaptive models that thrive under evolving socio-economic conditions. This is particularly relevant as we design learning environments for Generation Alpha and Beta—digital natives with evolving cognitive patterns and educational expectations.

As Kozma (2005) asserted, the transformative potential of ICT in education depends largely on how it is integrated into EdTech curricula, teacher practices, and institutional planning. This view complements more recent frameworks of EdTech for equity (Pimmer, Mateescu, & Gröhbiel, 2016), which argued that inclusivity must be engineered into systems, not retrofitted. This study did not merely catalogue technological tools or digital platforms. Instead, it interrogated the systemic conditions under which EdTech can become a truly equitable force. Through empirical insights from academic

practitioners, policy frameworks, and cross-national literature, the study aimed to construct a nuanced narrative that recognises digital equity not as a byproduct of EdTech, but as its ultimate test.

Review of Literature

Katz and Levine (2015) investigated digital equity among Hispanic families in the U.S., revealing that while devices and connectivity were increasing, meaningful access depended heavily on cultural context and parental digital literacy. Their mixed-methods study uncovered how language barriers and limited understanding of educational platforms hindered actual engagement, despite the presence of hardware and basic internet access. Basham, Stahl, Ortiz, Rice, and Smith (2015) analysed K–12 online learning for students with disabilities, documenting early evidence that online environments often failed to meet the specialised needs of learners with IEPs. Their exploratory work questioned whether online systems offered sufficient accommodations, prompting calls for more targeted support designs for equitable educational outcomes. Warschauer and Matuchniak (2015) provided a foundational review in *Review of Research in Education*, arguing that achieving equity in EdTech required advancing from simple device distribution to integrating pedagogical strategies, teacher training, and curriculum redesign. They emphasised that access must be accompanied by effective usage—an idea that became a recurring theme in digital equity discourse.

The Center on Online Learning and Students with Disabilities (2016) (the "Equity Matters" report) synthesised research on virtual and blended education for differently-abled students or students with disabilities. It traced structural strengths and weaknesses across U.S. states, calling for clearer policies, enhanced teacher preparation, and better-designed online platforms to ensure equity in both access and educational outcomes. Selwyn and Facer (2016) critically examined the EdTech agenda in *Learning, Media and Technology*, challenging the assumption that more educational technology naturally leads to improved equity. They highlighted how market-driven models often neglected the complexities of socio-economic and cultural contexts, suggesting that equitable EdTech required more than just scaling devices—it needed systemic rethinking. Trucano and Kozma (2016) assessed over 40 national-level digital learning initiatives, arguing that infrastructure investments often failed when they didn't align with linguistic, pedagogical,

and curricular realities. Their policy-oriented study concluded that strategic planning, capacity building, and locally relevant content were critical to turn device distributions into effective learning opportunities.

Moore and Vitale (2017)**,** through a large-scale survey for ACT, documented persistent inequities related to device access and connectivity among secondary school students. They emphasised policy measures such as subsidised internet and stronger mobile access to address a "homework gap" exacerbating rural and low-income learning challenges. MIT Initiative (Klein, 2017) reaffirmed that despite ubiquitous devices and mobile broadband, deep divides remained, especially between rural and urban, and wealthy versus underprivileged regions. Their analysis reinforced that infrastructure alone was insufficient without complementary educational programmes and equitable policies. Bishop and Lee (2017) proposed equity-centered approaches to EdTech in the *Handbook of Research in Educational Communications and Technology*. They outlined how intentional design could support historically marginalised learners, emphasising the inclusion of equity perspectives in all stages of educational technology development.

Moore and Vitale (2018) revisited the "homework gap," this time with national survey data, describing it as a systemic barrier where device access in schools didn't translate to home learning capability. Their policy analysis pushed for a reimagining of broadband as essential infrastructure, akin to electricity and water, and called on governments to subsidise or regulate internet provision as a public good. Hanover Research (2018) provided district-level case studies showing how technology integration often failed due to lack of teacher training, inadequate digital literacy, and rigid curricula unsuited for blended learning. Their findings advocated for holistic technology strategies addressing pedagogy, professional development, and content redesign. ACT (Moore & Vitale, 2018) further emphasised that equitable access required reliable connections, multi-device availability, and support across home and school, along with policies to ensure underserved students weren't left behind.

Nakayama et al. (2019) conducted a study in Brazil analysing digital inclusion for rural youth. They found that infrastructural improvements alone did not reduce inequities—effective outcomes depended on localised educational interventions, teacher training, and culturally relevant content. Education

without community engagement failed to shift persistent disparities. Dimaggio, Hargittai, Celeste, & Shafer (2019) examined second and third-level digital divides—access, skills, and usage among U.S. adults. Their large–scale survey revealed that income, education, age, and ethnicity were powerful predictors of digital engagement, shaping the quality and outcome of technology-mediated learning experiences.

Reimers and Schleicher (2020), in a global OECD report on COVID-19 responses, highlighted that robust EdTech preparedness correlated with minimal learning disruptions during school closures. However, equity was not assured; marginalised learners in under-resourced communities suffered greatest losses, underscoring that infrastructure must be paired with equity strategies. UNESCO (2020) documented that 40–65% of schools globally lacked adequate connectivity. They argued device distribution schemes often failed due to absent teacher training and curriculum alignment, calling for comprehensive digital education frameworks that emphasise equity and teacher capacity.

Cruz (2021) studied Indian rural-urban EdTech disparities, documenting how women and rural students faced compounded barriers in access and engagement. Her qualitative data revealed social norms, device sharing, and unreliable internet combined to disproportionately limit their learning opportunities. Bulut et al. (2021) explored algorithmic fairness in AI-based educational measurement. They concluded that without rigorous ethical frameworks, AI tools could perpetuate biases and further marginalize underrepresented students, even as they offered scalable assessment potential.

Chaudhry, Cukurova and Luckin (2022) developed a Transparency Index for AI EdTech, co-designed with educators and technologists. They emphasised that ethical, equitable AI requires transparency across data sources, model processes, and decision-making, crucial to ensuring trust and fairness in educational contexts. Fenu, Galici and Marras (2022) conducted interviews with EdTech AI experts, identifying fairness, accountability, and representativeness as key challenges. They urged for standardised auditing mechanisms to detect and correct algorithmic bias before deployment in classrooms.

Gillani, Eynon, Chiabaut & Finkel (2023) issued a clarifying essay on AI in education’s 'black box.' They advocated demystifying AI, defining terms,

methods, and limitations, to empower educators, administrators, parents, and learners to engage critically and prevent unchecked adoption. D'Agostino (2023) analysed the emerging "AI literacy divide" in higher education. She argued that students with decentralised access to AI tools developed prompt-engineering skills while others fell further behind, reinforcing that equitable educational ecosystems must include AI literacy and support as fundamental components, not optional add-ons.

Liu et al. (2024) examined generative AI integration in schools, warning that tools like ChatGPT often neglect non-Western cultures and languages. They recommended policies that mandate translation support, diverse cultural training datasets, and subsidised access to high-quality AI platforms for all learners. OECD (2024) released guidelines stressing four pillars of AI equity in education: universal access to connectivity, AI literacy among teachers, transparent ethical standards, and quality assurance in AI tool deployment. They explicitly linked these pillars with the UN Sustainable Development Goal 4 for inclusive education.

Graf, Peng & Dumitru (2025) presented empirical evidence that AI-based adaptive programming education significantly improved learning outcomes and engagement among socioeconomically disadvantaged students. Their real-world implementation demonstrated that personalised, responsive learning pathways could reduce performance gaps. Chasokela and Sithole (2025) explored AI's role in sustainable development education. They emphasised that AI tools must be equity-centered from design to assessment, aligning pedagogical goals with social justice and global competencies. Loble and Stephens (2025) proposed an Australian Digital Equity Guarantee, conceptualising AI and EdTech policy through four equity dimensions: access, data, design, and effective use. Their framework offers a model for system‑level integration of digital equity in national education strategies.

Research Gaps

While the extant literature has significantly expanded our understanding of educational technology (EdTech) and its role in shaping learning outcomes globally, several critical gaps persist, particularly when viewed through the lens of digital equity. Numerous studies from 2015 to 2025 have highlighted disparities in access, infrastructural limitations, and algorithmic bias, yet they often approach these issues in isolation. There remains a noticeable deficiency

in integrative research that examines EdTech as a multifaceted ecosystem, where infrastructure, pedagogy, governance, digital literacy, and cultural relevance must operate in concert to ensure equity and sustainability.

Most existing scholarship has concentrated on either technological deployment or digital access metrics (e.g., broadband penetration, device availability). However, few have deeply investigated how these tools intersect with localised sociotechnical systems—such as teacher competencies, community-level policy adaptations, and the socio-cultural dimensions of digital literacy. This leaves a gap in understanding how context-sensitive and pedagogically aligned EdTech solutions can be scaled while maintaining affordability and resilience across diverse learning environments.

Additionally, although international organisations like UNESCO and OECD have provided frameworks for equitable technology integration, there is insufficient empirical research on the collaborative roles of public, private, and civil society actors in creating sustainable EdTech infrastructures. Questions remain about how these stakeholders can align incentives, resources, and responsibilities to produce scalable and high-quality educational experiences that do not reinforce existing hierarchies.

Emerging technologies—such as AI-driven learning platforms—have not yet been comprehensively evaluated for their long-term equity outcomes, particularly in low-resource settings. Much of the current work focuses on AI's capabilities rather than its social consequences. This highlights a major gap in investigating inclusive design, participatory deployment, and ethical governance as central components of educational AI systems. Thus, this study addressed the unmet need for a holistic inquiry into how EdTech can be deliberately designed and collaboratively implemented to foster digital equity, not only through improved access, but also through structural transformation of educational delivery models across the globe.

Research Objectives

- To explore how EdTech can be leveraged to promote digital equity by ensuring universal, affordable, and resilient access to education across diverse global contexts.

- To examine the sociotechnical systems, including infrastructure, pedagogy, policy, and digital literacy, that influence the equitable and sustainable implementation of educational technologies.
- To identify scalable strategies and collaborative models involving public, private, and community stakeholders that can deliver cost-effective, high-quality, and context-sensitive global learning solutions.

Research Methodology

Secondary data-based research methodology refers to the process of systematically collecting, analysing, and interpreting information that has already been generated, published, or archived by other researchers, institutions, or organizations. This approach is particularly valuable in studies that aim to explore broad, complex, or global phenomena, such as digital equity in education, where direct primary data collection may be constrained by time, geography, or resources. In the context of this study, which investigated the role of EdTech in advancing accessible, affordable, and sustainable global learning, secondary data serves as a foundational tool for contextual understanding and comparative analysis. The methodology began with identifying credible and relevant sources from peer-reviewed journals, reports, and other published work. Special attention was paid to the credibility, timeliness, and scope of the data, ensuring that the literature spanned a decade and covered wide perspectives. These data sources included empirical studies, policy evaluations, conceptual frameworks, etc. related to EdTech deployment and digital equity. The secondary data was then thematically organised and synthesised, aligning with the key research objectives. A key strength of secondary data research is its ability to draw on large-scale, cross-cultural, or long-term datasets that would be challenging to replicate through primary methods. However, this approach also necessitates caution in terms of contextual relevance, data currency, and the original intent of the collected information.

Data Analysis

Objective 1: Access, Affordability and Equity

- **Device and Internet Access**

The Annual Status of Education Report (ASER, 2022) documented that rural households in India have access to a smartphone, but have reliable internet

connectivity issue-that have improved post-pandemic. Government evaluations of Edtech platforms show that while platform adoption increased during COVID-19, actual active usage remained low in some states (National Education Policy 2020).

- **Affordability constraints persist:**

The Telecom Regulatory Authority of India (TRAI, 2023) revealed that despite competitive data pricing, 1 GB monthly plans remain a burden for families earning <₹10,000 per month. As Sharma and Rao (2021) argued, the affordability gap is as much social as economic; even when devices are technically accessible, costs of maintenance, electricity, and data limit sustainable engagement.

- **Resilience of Learning Systems**

UNESCO-Delhi's 2021 report highlighted how EdTech initiatives in some states maintained educational continuity during crises thanks to hybrid models blending radio, SMS, and student volunteer networks. In contrast, schools in other states reported abandonment of digital teaching after four months due to lack of infrastructure and training (UNESCO, 2021). A study by Kumar et al. (2022) also found that solar-powered labs helped improve EdTech resilience in remote districts, countering frequent blackouts and supporting offline-capable e-content. These local interventions align with global best practices on resilient education systems (Reimers & Schleicher, 2020).

Objective 2: Sociotechnical Systems Analysis

Infrastructure & Platform Readiness

Data from the Ministry of Electronics and Information Technology (MeitY) in 2022 showed that not every government and private schools have functional computer labs with internet connectivity. Evaluations of EdTech platforms revealed intermittent updates, engagement and interaction level with little integration into mainstream curriculum (Prakash & Mehra, 2020). Research by Singh and Joshi (2023) confirmed that EdTech adoption is highest in states where robust platforms align with syllabus, training, support, and localized content.

- **Pedagogical Integration & Teacher Preparedness**

NEP 2020 directs training all educators in digital pedagogy, yet NCTE (2021) reports indicated that teacher-training institutions are offering competency-based ICT programmes. Vidyarthi & Sinha (2022) observed that teachers view digital tools more as administrative aids and less as pedagogical enhancers—mirroring findings from global literature about passive rather than active integration (Hill & Sharma, 2020). Case studies of EdTech platforms revealed success when teacher training is continuous and contextual, with district-level mentorship and peer learning. The ASER Learning Barometer (2023) reported a marked improvement in digitally facilitated learning following training interventions.

- **Policy Implementation & Governance Networks**

While NEP 2020 outlined digital equity goals, lack of operational coordination hinders results. A 2023 Comptroller & Auditor General (CAG) report criticised bottlenecks such as delayed content localisation, platform interoperability issues, and low teacher compliance. Gujarat Recharge Model and Karnataka's Smart Classrooms programme are frequently cited as contrasting successful examples of decentralised decision-making and civil society engagement (Desai & Patel, 2022).

- **Digital Literacy Among Students and Communities**

Rural digital literacy is low; however, students in different states can navigate online assessments independently, although girls and boys have some socio-cultural constraints (Kumar & Singh, 2021). National literacy campaigns showed improved basic usage and addressed critical pedagogical literacy and language proficiency (Mehrotra, 2022).

Objective 3: Scalable Collaborative Models

Public–Private Partnerships

Public–Private–NGO partnerships are gaining traction. Tata Trusts' ClassEdge partnered innovatively with state governments to provide curriculum-integrated EdTech, achieving increasing usage in different states (Tata Trusts, 2022). Similarly, Microsoft's 'Project Nanhi Kali' demonstrated success in supplementing state efforts with locally relevant teacher training and device provision (Microsoft India, 2023).

- **Community-Led Initiatives**

Community-driven projects utilise student ambassadors, parent-teacher committees, and local NGOs to run digital labs. NGO-led evaluations (PRADAN, 2022) showed that community-anchored models increase both usage and content relevance, leading to higher student engagement.

- **Customisable and Localised Platforms**

Some EdTech platforms allow states to customise content; many states have developed regional courses. The localised approaches align with global observations that top-down EdTech fails without flexibility (UNESCO, 2022).

Emerging Technologies & Opportunities

- **AI in Education**

Research by Srivastava (2023) showed AI chatbots in English and Hindi improved learning in selective schools. Yet, the lack of regional-language AI and concerns about cultural bias limit broader adoption.

- **Mobile Learning**

Study indicated that rural families share at most one smartphone among four individuals (TRAI, 2023). While WhatsApp-based learning is ubiquitous, content overload and lack of interactivity limit its effectiveness. A study by Verma and Rao (2022) suggested that low-cost mobile strategies must balance interactivity with bandwidth limitations.

- **Open Educational Resources (OERs)**

National Digital library has very good assets. However, Prakash and Mehra (2020) noted that routine usage by all teachers is an issue due to relevance or lack of training. Localisation could improve usage (ASER, 2023).

Strategic Insights

- Equity requires multi-tiered investment: digital access, training, local content, and governance.
- Localised EdTech design is essential to equitable scale.
- More community engagement can enhance both access and use.
- Emerging tech like AI and OER must be adapted for low-resource settings.

- Capacity building and policy implementation remain under‑resourced links in the EdTech ecosystem.

Findings and Discussion

Digital Equity: Access, Affordability, and Resilience

Affordability as a Core Barrier

ASER (2022) illustrated that there is increasing use of smartphone in rural Indian households but have consistent internet access issue. This lack of affordability, confirmed by TRAI (2023) findings on data costs, directly undermined the first research objective. It showed that even with policy initiatives to distribute devices, recurring expenses—data, repairs, electricity erode sustained use. This supports the literature (Selwyn & Jandrić, 2022) emphasising that EdTech equity demands more than short-term funding; it needs long-term subsidies and cost-sharing models.

- **Resilience: Beyond Device Distribution**

The study highlighted that while some regions built resilient learning systems, others lost momentum once short-term funding ended. Local solutions such as solar labs (Kumar et al., 2022) illustrate effective technical resilience but require integration with teacher training and content localization for long-term impact. This triangulates with UNESCO's findings on hybrid learning approaches and affirms that resilience is an ecosystem—not just hardware.

Sociotechnical Systems: Infrastructure, Pedagogy, Policy, and Digital Literacy

- **Infrastructural Readiness**

Minimum digital infrastructure standards in each and every school is a matter of concern. Secondary reports (MoE, 2020; MeitY, 2022) and Singh and Joshi (2023) showed uneven state-level distribution of ICT capacity. These structural gaps impede objective two by blocking meaningful EdTech integration. Digital divide analysis indicates that policy emphasis should shift from procurement of devices to sustainable ICT infrastructure development in all schools.

Pedagogical Integration Clauses

Significant disparity exists between policy aspiration and ground-level pedagogy (NCTE, 2021). Teachers largely employ EdTech as an administrative convenience, not as an interactive instructional tool (Vidyarthi & Sinha, 2022). District-level mentorship programme, in contrast, demonstrates that structured, context-sensitive professional development can transform EdTech usage.

Policy Execution Gaps

NEP 2020 and digitisation goals are ambitious, yet as the Comptroller & Auditor General (2023) highlighted, content localisation, interoperability, and teacher involvement remain a question. Successful states share traits: decentralized decision-making, routine monitoring, and civil-society integration. These observations align with Reimers and Schleicher (2020), who argue that agility and local ownership are key success drivers.

Digital Literacy and Equity

Digital literacy-especially among girls and low-income students—remains severely limited (Kumar & Singh, 2021). Utility of EdTech platforms is hampered by literacy barriers. The disadvantage results from device-sharing norms and patriarchal constraints. National literacy programs improve basic digital use but overlook critical pedagogical and language aspects (Mehrotra, 2022). These findings affirm that digital literacy is not just technical fluency—it is about functional, critical, and cultural competency.

Scalable and Collaborative Models

- **Public-Private Partnership Effectiveness**

Tata ClassEdge and Microsoft's Project Nanhi Kali highlighted how PPPs can scale while maintaining local relevance. They mobilise state infrastructure—schools, teachers—with private expertise—tech solutions, capacity-building. These models outperform wholly public or private interventions by combining stable funding with innovation and community trust, fulfilling Objective 3.

- **Community Ownership**

Projects in different states show stronger engagement where communities manage labs, content, and troubleshooting. Community-anchored EdTech is more sustainable and usage-intensive. These align with global insights from

UNESCO (2022) stressing the importance of local adaptation and bottom-up governance.

- **Localisation and Customization**

DIKSHA's multi-language capabilities, and successful localization, underscore the importance of curricular contextualization. Such approaches mitigate the risk of "curriculum monoculture." But execution irregularities suggest that customization capabilities must be institutionalized within national platforms for uniform accessibility.

Regional & Contextual Disparities

- **Urban–Rural and State-Level Inequities**

Data highlights stark divides: some states are excelling in EdTech integration, while others lag substantially across all performance metrics. This regional inequity demonstrates the need for policy specificity and decentralised implementation strategies that respect local contexts.

- **Socio-Cultural Barriers**

Patterns such as gendered device sharing and reluctance toward digital learning point to socio-cultural inhibitors not fully captured in infrastructure investments. These must be addressed via targeted inclusion strategies - e.g., mobile labs for all students, safe community spaces for device access, mentorship programmes, etc.

Emerging Technologies: Opportunity and Oversight

- **AI-Powered Learning**

Early implementations, such as chatbots for primary education show promise but stress the need for culturally aware, linguistically inclusive models. As predicted in literature, algorithmic bias and language exclusivity limit equitable outcomes unless equity is embedded in system design.

- **Mobile Learning in Rural Contexts**

With high mobile penetration but low device ownership per individual, mobile-first EdTech strategies must account for multi-user usage, shared data

constraints, and limited content interactivity. Low-cost voice and SMS solutions offer promising approaches.

- **Open Educational Resources (OERs)**

DIKSHA's vast repository provides accessible educational content, yet an utilisation rate is a matter of concern. Teacher training, curricular embedding, and content localisation are required to transform OERs into usable classroom resources.

Strategic Insights

- **Multi-Tiered Investment Strategy**

Findings stressed that digital equity demands investment beyond procurement. Infrastructure, teacher training, content localisation, community engagement, and governance instruments must be funded and coordinated across government tiers.

- **Localisation as a Core Principle**

Customization—linguistic, cultural, pedagogical- must be embedded into platform architecture and policy frameworks. Local stakeholder participation enhances ownership, usage consistency, and learning outcomes.

- **Strengthening Digital Literacy**

Digital skill-building must include critical, cultural, and language dimensions. EdTech Programmes should pivot to advanced, equity-related literacy modules and target marginal groups with specialized outreach.

- **Regulation and Equity Governance**

Emerging EdTech sectors—AI tools, OER repositories-require built-in equity standards, algorithmic audits, and transparent governance to prevent replication of offline disparities.

Conclusion

The evolving landscape of education in the 21st century is deeply interwoven with the rise of educational technologies (EdTech), especially in the context of ensuring digital equity. As this research set out to explore, EdTech holds

remarkable potential to democratise learning across geographies, socioeconomic divides, and cultural contexts. However, its transformative power is not inherent-it must be intentionally harnessed through thoughtful design, inclusive policy frameworks, and collaborative implementation models. This study, grounded in extensive secondary data analysis, has illuminated both the promise and the persistent limitations of EdTech in achieving truly accessible, affordable, and sustainable global learning.

The first research objective—to understand how EdTech can be leveraged to ensure universal, affordable, and resilient education—revealed a complex matrix of challenges and opportunities. While significant efforts have been made at national and state levels to distribute digital devices, improve internet infrastructure, and provide open educational resources, these efforts remain unevenly distributed and inconsistently adopted. Affordability continues to be a central barrier, particularly in rural and economically marginalized communities. Although smartphone penetration has grown, device sharing and data affordability issues limit effective access in groups. Moreover, resilience in EdTech systems requires more than hardware; it demands robust support mechanisms, technical training, and localized content that evolves with pedagogical needs and technological advancement.

The second objective focused on the sociotechnical systems—policy, pedagogy, infrastructure, and digital literacy—that shape equitable and sustainable implementation. The study affirmed that infrastructure alone does not guarantee educational impact. Digital equity is intrinsically tied to the quality of interaction between users (students, teachers), tools (platforms, devices), and systems (curriculum, evaluation). The National Education Policy (2020) rightly emphasised digital inclusion, but actual deployment across states is hampered by fragmented governance, inadequate monitoring, and insufficient teacher preparation. Teacher digital fluency remains a weak link in the chain, not just in terms of basic tool usage, but in integrating EdTech meaningfully into instructional strategies. Furthermore, while some private platforms and government initiatives have made strides in content development, the lack of linguistic, cultural, and regional localization significantly dilutes the inclusivity and efficacy of EdTech interventions.

A key insight drawn from the study is the limited scope of digital literacy programmes in addressing the deeper, structural inequities embedded within

the digital learning ecosystem. Literacy is too often narrowly defined as operational proficiency—navigating a device or opening an app—whereas true digital equity requires critical digital skills: the ability to evaluate content, participate meaningfully in virtual learning spaces, and exercise agency in one's own educational journey. Moreover, cultural biases, algorithmic invisibilities, and gendered restrictions on device access further complicate the equity landscape.

The third objective-identifying scalable, collaborative models- emerged as one of the most fertile areas for innovation and policy intervention. Multi-stakeholder partnerships, especially those involving public institutions, private technology providers, NGOs, and local communities, have shown considerable potential in extending reach and contextual sensitivity. Projects that embed communities as co-creators, not just beneficiaries, of digital solutions tend to enjoy higher sustainability, relevance, and local ownership. Initiatives like mobile learning buses, community EdTech facilitators, and hybrid learning hubs serve as practical, scalable models that can be tailored to different geographies and learner profiles.

In the Indian context, the diversity of EdTech landscapes across states illustrates the critical importance of decentralised, context-responsive policy approaches. While some states have leveraged strong governance and public-private synergies to build robust digital ecosystems, some lag behind due to bureaucratic inertia, underinvestment, or lack of grassroots engagement. This disparity underscores the need for national frameworks that are flexible and adaptive, allowing for innovation at the local level while maintaining coherence and quality assurance.

What also became evident is the untapped potential of emerging technologies like Artificial Intelligence (AI), adaptive learning systems, and gamification. When thoughtfully implemented, these tools can personalise learning, track learner progress, and make education more interactive and engaging. However, they also introduce new ethical and equity concerns—bias in AI algorithms, data privacy issues, and the risk of further marginalising digitally unprepared learners. Thus, any advancement in EdTech must be coupled with rigorous regulatory oversight and inclusive design principles that centre the learner's context and rights.

This study reaffirmed a core truth: technology alone cannot resolve educational inequities. It must be embedded in a larger human-centred framework that prioritises equity, dignity, and meaningful participation for all learners. EdTech is not a silver bullet, but a powerful tool that, when guided by inclusive principles and localised strategies, can expand the reach, relevance, and resilience of global education systems.

The implications of these findings are both urgent and optimistic. As we move further into an era defined by digital disruption and generational shifts—especially with the rise of Gen Alpha and Gen Beta—there is a critical window of opportunity to shape a more equitable educational future. Policymakers must go beyond infrastructure funding and develop robust strategies for content localization, teacher training, and digital citizenship education. Technology companies must design with empathy and inclusivity in mind, prioritizing low-bandwidth, multi-language, and offline-compatible solutions. Academic institutions and civil society must act as bridges-translating global innovations into locally grounded interventions that are relevant, effective, and empowering.

The study offered a comprehensive lens on the potential and pitfalls of EdTech in promoting digital equity. By illuminating the structural, pedagogical, and collaborative dimensions of equitable EdTech ecosystems, the study not only addressed critical research gaps but also provided actionable insights for diverse stakeholders. A globally connected, digitally inclusive education system is not a distant dream—it is a deliberate project that demands vision, collaboration, and sustained commitment from all actors involved.

Future Implications

As digital learning becomes increasingly central to global education systems, especially in the post-pandemic world, it is imperative that future policies surrounding EdTech and digital equity evolve beyond short-term infrastructural goals to more holistic, inclusive, and sustainable frameworks. The insights gained from this study suggest several key policy directions:

- **Equity-Centered Design in EdTech Policies**

Governments must develop policies that embed equity as a foundational principle—not as an afterthought. This involves mandating universal access to

basic digital infrastructure (devices, internet, electricity), but also ensuring affordability through subsidies, community resource centers, and low-cost public technologies. Policies must be targeted at the most digitally excluded groups, including rural learners, tribal communities, persons with disabilities, and especially girls, who often face intra-household digital restrictions.

- **Localised and Multilingual Content Development**

A significant policy gap lies in the lack of culturally relevant, linguistically diverse, and curriculum-aligned digital content. Future policy must prioritise regional content development through local partnerships with educational institutions, NGOs, and grassroots innovators. EdTech platforms should incorporate regional boards, student voices, and teacher feedback into iterative content design.

- **Institutional Support for Teachers' Digital Readiness**

A digitally enabled classroom is only as effective as the teacher's ability to facilitate it. Future policy frameworks should make digital pedagogical training a mandatory component of teacher education. Continuous professional development programmes must be decentralised, contextually appropriate, and incentivised through career progression pathways.

- **Public-Private-People Partnerships (PPPP)**

To scale EdTech solutions while preserving quality and inclusivity, governments must craft collaborative policy ecosystems that include private sector innovation, public education infrastructure, and civil society's community knowledge. Future policies should support blended models that combine online platforms with offline, community-based learning hubs. Regulatory guidelines should ensure private sector accountability in terms of data privacy, affordability, and learner inclusivity.

- **Resilience-Oriented Digital Infrastructure Planning**

Post-pandemic, the concept of educational continuity in emergencies must be embedded into national education plans. Policies must support the creation of hybrid and asynchronous models that are resilient to disruptions (pandemics, natural disasters, conflict zones). Battery-operated devices, solar-powered

learning kiosks, and offline learning apps should be integrated into disaster management education policies.

- **Monitoring, Data, and Feedback Loops**

A lack of reliable and disaggregated data continues to hamper effective EdTech policy implementation. Future policy must invest in data systems that monitor EdTech usage, learner outcomes, digital exclusion patterns, and teacher capacity. However, such data must be used ethically, avoiding surveillance or punitive approaches, and instead promoting a continuous improvement cycle.

Limitations of the Study

Despite the comprehensive scope of this study, certain limitations must be acknowledged to contextualise the findings and recommendations. First and foremost, the research relies on secondary data, drawing from published reports, academic journals, policy documents, and publicly available databases. While this allows for a broad analytical perspective and helps capture established trends in EdTech and digital equity, it inherently lacks the depth and immediacy of real-time field data. The absence of rich primary data, especially from underserved communities, limited the ability of this study to capture the nuanced, lived experiences of learners and educators who are most affected by digital exclusion. Additionally, the study, though global in intent, had a strong country-centric focus. This geographic emphasis was deliberate, as it represented a large and complex educational ecosystem with diverse EdTech experiments and digital inclusion policies. However, this focus also restricted the generalisability of the findings to other national contexts, particularly those with different political, economic, and infrastructural realities. While some strategies discussed may resonate with other countries, cultural, policy, and infrastructural differences should be taken into account when applying the insights elsewhere.

Another limitation stemmed from the absence of quantitative primary research. The study did not incorporate large-scale surveys or statistical models to validate the patterns and challenges identified in the secondary sources. Quantitative data on the actual usage patterns, learning outcomes, and engagement levels with EdTech across different socioeconomic strata could have strengthened the empirical foundation of the conclusions. Future research would benefit from mixed-method approaches that combine the

breadth of secondary data with the depth and rigor of field-based quantitative and qualitative assessments.

Furthermore, the rapid evolution of technology presents a temporal challenge. The EdTech landscape changes swiftly—platforms, pedagogies, and policies often undergo significant transformations within short timeframes. As such, there was a natural time-lag between data collection, analysis, and publication, which might render some insights less applicable by the time they reach policymakers or practitioners. This dynamic nature of technology should necessitate continual research updates and iterative policy frameworks.

Lastly, despite efforts to analyse inclusive strategies, the study might have inadvertently underrepresented the voices of the most marginalised groups—such as children with disabilities, indigenous learners, and migrant families. These populations often face unique digital and cultural barriers that mainstream data sources do not adequately capture. Without their active participation in research processes, there is a risk of reinforcing generalised solutions that fail to address specific, intersectional vulnerabilities. Thus, future studies must adopt participatory and ethnographic methods to bridge this gap and ensure that digital equity frameworks are truly inclusive. While the current research provided a critical foundation for understanding how EdTech can foster digital equity in education, these limitations ed the need for further, ground-level, interdisciplinary, and intersectional inquiry.

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CHAPTER NINE

Patient's Expectation Factor on Drug Dispensing Pattern of Patent and Proprietary Medicine Vendors in Kwara State, Nigeria

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Abstract

This study assessed the effect of patient's expectation on drug dispensing pattern of PPMVs. The study was a cross-sectional study design among randomly selected 389 PPMVs. A mixed (quantitative & qualitative) method of data collection was used. Data were collected, collated and analysed using Statistical Product and Service Solutions (SPSS, version 28.0), and the level of significance was set at $p < 0.05$. The majority (89.5%) of respondents reported that patient expectations moderately influenced their dispensing habits, and only a small percentage 6.9% felt patient expectations had little to no influence on their dispensing pattern. This is further buttressed by the Key Informant Interview with some of the PPMVs. The study further revealed that patient demand, among other factors such as peer pressure, financial incentives and regulatory pressure, acts as a barrier to appropriate dispensing. The vast majority (85.1%) of respondents considered patient demand for a specific drug as a moderate barrier to a more rational dispensing. Therefore, this study showed that patient pressure is a significant factor influencing the drug dispensing pattern of PPMVs. The study recommended the creation of enlightenment programmes on rational drug use starting at the grassroots level, and encouragement of care-seeking and consultation.

Keywords: Patient's expectation, Drug dispensing Pattern, PPMVs, Kwara,

Introduction

In many low- and middle-income countries, the private sector provides a significant portion of healthcare services. In Sub-Saharan Africa, around half of all child health services are provided by private providers, which range

from traditional healers and informal providers to privately owned specialty hospitals. In particular, drug shops account for between 15% and 83% of all child health services and make up a sizeable portion (nearly 40%) of the region's private healthcare sector. Several countries in Sub-Saharan Africa have included private drug retailers in national health interventions to address the role of the retail drug sector.

A primary supply of medication for acute ailments in Nigeria is owner-operated drug retail businesses, often known as patent and proprietary medicine vendors (PPMVs). According to national studies, PPMVs treat between 8% and 55% of diseases in children under five as their primary care provider. Similar findings have been made by community- and state-level research on care-seeking behavior: PPMVs treat between 35% and 55% of adults seeking treatment for malaria and are the initial point of care for up to 55% of diseases affecting children under the age of five (Beyeler et al., 2015).

There is no formal training need for PPMV licensing in medicine or pharmacy. Instead, a lot of PPMVs do an apprenticeship under a more experienced PPMV before starting their own business, and they are often expected to have finished elementary school. The National rules allow PPMVs to provide a restricted range of pre-packaged, over-the-counter pharmaceuticals and medical supplies, but they are not allowed to perform invasive medical procedures (such as injections) or sell prescription drugs, including antibiotics.

In the context of patent and proprietary medicines vendors (PPMVs) in Nigeria, drug dispensing refers to the process by which these vendors, who are not licensed medical professionals, issue medications or drugs to patients.

Ensuring that everyone has access to high-quality healthcare services regardless of where they reside is known as Universal Health Coverage (UHC). Many nations, including Nigeria, have made achieving UHC a top goal. To do this, they must make the most of the material and human resources that the public and private sectors have to offer. The private sector is a major player in the delivery of health care in many resource-poor nations, such as Nigeria, where it serves a sizeable section of the populace.

For instance, the 2018 Nigeria Demographic and Health Survey (NDHS) revealed that 33% of women gave birth in an institution and 41% of users obtained contemporary contraception from the commercial sector. Treatment

for pediatric diseases was sought by 62.3% of children under five who had fever, 63.5% who had diarrhea, and 50.5% who had acute

The proprietary vendors, popularly referred to as patent and proprietary medicine vendors (PPMVs), is defined as "individuals without formal pharmacy training selling orthodox pharmaceutical products on a retail basis for profit," are notable members of Nigeria's private sector. An estimated 200,000 PPMVs exist in Nigeria. For most Nigerians, PPMVs serve as the first line of treatment, offering family planning, treatment for malaria, diarrhea, pneumonia, and other illnesses, and tending to both adults and children, particularly in rural areas.

The PPMVs also have many qualities that appeal to members of the community such as long opening hours, hospitability, and more consistent availability than public facilities that frequently experience service interruptions. Given their widespread presence, well-regulated and well-trained PPMVs could boost Nigeria’s progress towards UHC by being more involved in promising health interventions such as integrated community case management (iCCM) (Oyeyemi et al., 2020).

The development of antibiotics has fundamentally changed healthcare delivery and reduced the global morbidity and mortality rate from infectious diseases. However, the global emergence of antimicrobial resistance organisms (AMRO) and the accompanying difficult-to-treat infections, prolonged hospital stays, higher healthcare costs, and worse health outcomes are the result of, among other factors, microbial evolution, antibiotic misuse, and inadequate infection control practices. Developing nations in Asia and Africa are most vulnerable to the growing global danger posed by antibiotic resistance. If nothing is done to stop the rising trend of antimicrobial resistance (AMR), it is predicted that by 2050, 10 million people worldwide each year—roughly 4 million in each of Asia and Africa—will pass away from AMR (Achi et al., 2021).

PPMVs are legally allowed to offer a restricted quantity of pre-packaged Over-The-Counter (OTC) medications.Although formal training in medicine or pharmacy is not necessary for a PPMV license, most PPMVs do an apprenticeship with a more experienced member of the profession before opening their store. Conventionally, the minimum educational level has been primary schools. Customer demand frequently determines the goods and

services offered by PPMV shops since their main purpose is retail sales rather than healthcare, which could result in PPMVs operating outside of their legal boundaries (Prach et al., 2015).

PPMVs offer medications and services for a wide range of health needs, such as tuberculosis, respiratory infections, diarrhea, malaria, common colds, and reproductive health, but the quality of these treatments is poor, according to a recent comprehensive evaluation of PPMV practices.

Inappropriate drug prescription patterns can have negative consequences for patients, including adverse drug reactions, drug interactions, and increased healthcare costs. Therefore, it is important to promote appropriate drug prescription patterns and reduce inappropriate prescribing practices in healthcare facilities in Nigeria (Prach et al., 2015).

This is a controversial issue in Nigeria, as PPMVs are not legally authorised to dispense certain medications, but are often the primary source of healthcare for many people in rural areas. The quality and appropriateness of drug dispensed by PPMVs is a significant concern, as inappropriate drug use can lead to negative clinical and economic consequences (Kodaolu et al., 2020). Nigeria has one of the highest rates of irrational use of drugs in the world, often due to factors such as self-medication, over-the-counter access to antibiotics, and dispensing practices. Assessing the roles of PPMVs in this context is crucial.

Inappropriate drug use can lead to prolonged illnesses, increased healthcare costs, and adverse health outcomes. Improving dispensing practices can lead to cost savings for individuals and the healthcare system. Economic factors, patient expectations and demand among other factors may impact their dispensing habits. Understanding the economic motivations behind their dispensing pattern is crucial for designing effective interventions (Ogunleye et al., 2018). Hence, this study assessed the factors influencing drug dispensing pattern of PPMVs and the effect of patient expectation on their drug dispensing pattern.

Methodology

The study was conducted using a cross sectional design. Data were collected using both quantitative and qualitative (mixed) methods.

STUDY AREA:

The study area was Kwara State, which is the ninth-largest state by size among the 36 states in Nigeria. Geographically, Kwara State is divided into the Guinean forest-savanna mosaic ecoregion, occupying the majority of the state's interior, and the West Sudanian savanna in the west. Rivers are among the state's most notable geographical characteristics. The Awun, Asa, Aluko, and Oyun rivers run through the interior, while the Niger river flows along the state's northern border into Lake Jeba before continuing as a boundary (Kwara State Government, 2012).

Kwara State, which is situated in North Central Nigeria, has Ilorin as its capital. With 3,551,000 people living there as of the 2022 census, it was Nigeria's seventh-largest city in terms of population. The contemporary city is an industrial, economic, and educational hub surrounded by the ancient core area, which is made up of several mosques and typical red-mud single-story homes with thatched straw roofs that are all surrounded by a mud wall. (Kwara State Government, 2012).

To accommodate the demands of its citizens, Ilorin has a public transportation system that includes buses and taxis. In addition, the city has an airport that links it to other regions of Nigeria and the global community. The state's health policies and initiatives are developed and carried out by the Kwara State Ministry of Health. By offering high-quality healthcare services, encouraging healthy lifestyles, and avoiding illness, the ministry seeks to improve the health of the people of Kwara State (Fulani, 2011).

The city is home to foreigners and Nigerians, as well as members of the Yoruba, Fulani, Nupe, Bariba, Kanuri, Igbo, and Hausa ethnic groups. There are sizable communities of Muslims and Christians in the city, and several annual ceremonial events—the majority of which have religious overtones—take place there.

The respondents of this survey were Patent & Proprietary Medicines Vendors (PPMVs) who play a crucial role in delivering essential drugs to the communities in the Ilorin Metropolis.

This study included 400 respondents (trained PPMVs) although 389 questionnaires were retrieved across 2 selected LGAs in the state. For the

qualitative aspect of the study, the respondents were purposively selected from the study population.

A Multistage sampling technique was used.

Stage 1: Selection of Local government areas (LGAs): 2 LGAs were selected randomly from the 3 LGAs in Ilorin Metropolis using a simple random sampling technique by balloting.

Stage 2: Selection of PPMV Zones: In the two LGA selected (Ilorin South and Ilorin West), there are 28 zones (14 in each LGA); 8 zones were randomly selected from each LGA.

Stage 3: Selection of PPMV shops: from each of the zones selected, 25 PPMV shops were randomly selected

Stage 4: Selection of respondents: from each of the selected PPMVs shops, 1 PPMV was purposefully selected on whom the questionnaire was administered..

A convenient sampling was used to select three (3) key informants from each of the LGA, including the chairman. The interview was held at their various secretariats, and each session lasted for about 30 minutes. Permission was sought so that the information gotten from them was recorded and questions related to drugs dispensing and sales were asked.

The study main instrument, especially for the quantitative section of the study, was a semi-structured interviewer-administered questionnaire. Information was sought on the Drug Prescription Pattern of Patent and Proprietary Medicines Vendors (PPMVs) in Ilorin metropolis

For the qualitative component of the study, the instrument was the key informant interviews guide. Certain key points of interest were itemized in the form of questions to aid and guide the discussion. A record (audiotape) of the discussion was taken to ensure that no piece of information was missed.

Four research assistants were recruited for the study. The recruited assistants were trained on data collection methods, using both the quantitative and the qualitative methods.

The validated questionnaire was interviewer-administered. The trained four research assistants also guided the key informant interview for the PPMVs, ensuring that a record (audiotape) of the discussion was well documented.

Questionnaires were checked for errors and omissions at the end of the data collection period to ensure the correctness and completeness of the data. The data collected were checked daily for correctness and completeness. It was coded and analysed using the Statistical Product and Service Solutions (SSPS version 28.0) based on a predetermined analysis plan and the results were presented using tables and charts. Chi-square was used for test of association at $p<0.05$.

Qualitative data generated from KIIs with some PPMV owners were also analysed using transcript-based analysis.A copy of the proposal was submitted to the Ethical Review Committee of the University of Ilorin, Ilorin, Nigeria. The study was approved by the Committee with an approval number **UERC/ASN/2024/2777.** Informed consent was obtained from each participant after explaining the purpose of the study to them. Participants were interviewed after consent was granted for the study. To ensure confidentiality, no name was recorded on the questionnaire. However, codes by which selected PPMVs shops could be traced were generated for re-visiting. Study instruments were kept in a safe place and were only accessible to members of the research team.

Results

There were more females' respondents 289(74.3%) than male 100(25.7%). Most 204(52.4%) of the respondents had secondary and 177(45.5%) had tertiary education. While 2(.5%) had no formal Education, 6(1.5%) had primary. The age of the respondents indicated that 34(8.7%) were less than 25 years old, 238(61.2%) were between 25-40 years old, 108(27.8%) were between 41-55 years old, and 9(2.3%) were above 55 years old. The mean for age distributions was of 36.59 with 8.69 standard deviation.

Table 1: Factors Influencing Antibiotics Dispensing

Items	**Responses**	
	Frequency (N=389)	**Percentage (%)**
Patient demand	330	84.8
Diagnostic uncertainty	13	1.2

Economic incentives	44	4.1
Lack of access to diagnostic tools	291	27.3
Peer pressure	23	2.2
Insufficient training on antibiotic use	308	28.9
Lack of awareness about antibiotic resistance	34	3.2
Pharmaceutical marketing	7	0.7
Regulatory pressure	16	1.5

Multiple response

Table 1 above shows the factors influencing antibiotic dispensing. It shows the results of a survey on why respondents dispensed antibiotics. Respondents were allowed to choose multiple reasons. The most common reason reported by respondents was patient demand, with 84.8% of respondents saying this influenced their decision to dispense antibiotics. This means that more than a third of the time, respondents felt pressured by patients to dispense antibiotics.

Another common reason was lack of access to diagnostic tools, which was reported by 27% of respondents. This suggests that nearly a third of the time, respondents dispensed antibiotics because they couldn't accurately diagnose the illness.

Insufficient training on antibiotic use was another important factor, affecting 29% of drug sales. This means that almost a third of the time, respondents felt they may not have had enough training to know when antibiotics were truly necessary. Less common reasons for dispensing antibiotics included economic incentives (4%), peer pressure (2%), lack of awareness about antibiotic resistance (3%), pharmaceutical marketing (less than 1%), and regulatory pressure (1%).

Table 2: Influence of Patients' Expectations and Willingness of PPMVs to Participate in Trainings

Variables	Response	Frequency (N=389)	Percentage (%)
Do you think that the role of patient expectations has influence in your drug dispensing pattern?	Does not influence at all	9	2.3
	Slightly Influence	18	4.6
	Moderately Influence	348	89.5
	Strongly Influence	14	3.6
To what extent does patient demand for a drug act as a barrier to appropriate dispensing?	Not a Barrier at all	10	2.6
	Minor Barrier	46	11.8
	Moderate Barrier	331	85.1
	Significant Barrier	2	0.5
Would you be willing to participate in training programs aimed at improving antibiotic dispensing practices?	Yes	373	95.9
	No	16	4.1

Lastly, table 2 displays the respondents' willingness to participate in training programmes aimed at improving antibiotic dispensing practices. It revealed that a very high percentage (95.9%) of respondents expressed willingness to participate in training programmes to improve antibiotic dispensing practices. This highlights a strong desire among respondents to enhance their knowledge and effectiveness. Only a small number (4.1%) were not interested in such training.

Table 3: Common Conditions for Drug Dispensing

	Responses	
	Frequency	
	N=389	Percentage (%)
Typhoid fever (unconfirmed)	73	4.8
Common cold,	311	20.2

Diarrhoea (nonspecific),	37	2.4
Vaginal discharge (non-specific),	16	1.0
Fresh trauma wound,	14	0.9
Abdominal pain (non-specific),	16	1.0
Chest pain (non-specific)	26	1.7
Headache	357	23.2
Body pains/aches	354	23.0
Body itching	311	20.2
Body swellings (non-specific),	21	1.4

Multiple response

Table 3 shows the multiple-choice responses on conditions for drug dispensing. It revealed that the prominent conditions included headache (23.2%), Body pain/aches (23%), common cold, and body itching with 20.2% in both.

Table 4: Frequency of Specific Drug Requests, Availability and Dispensing of Antibiotics

Variables	**Response**	**Frequency (N=389)**	**Percentage (%)**
How often do customers request specific drugs or treatments?	Rarely	109	28.0
	Moderately	263	67.6
	Frequently	17	4.4
How often do you dispense antibiotics without a medical prescription?	Rarely	293	75.3
	Moderately	91	23.4
	Readily		
Antibiotics Availability	Available	54	13.9
	Not Readily Available	335	86.1

Table 4 shows the frequency of specific drug requests and dispensing of antibiotics. It indicated that more than two-thirds of the respondents, 263(67.6%) had a moderately frequent request for specific drugs, and 109(28%) rarely had such request. It also showed that about three-quarters, 293(75.3%) of the respondents rarely dispensed antibiotics.

Also on antibiotics availability, it indicated that the majority of the respondents 86.1% did not have it available, while only 13.9% had antibiotics readily available to them.

Key Informant Interview Report

Primary Products Typically Offered By the Patent and Proprietary Medicines Vendor

The PPMVs mainly procured and prescribed Over-the-Counter (OTC) drugs and common (old generation) antibiotics common to the people in every community. It was stated that 23 classes of drugs were approved for sale by the PPMVs. This was established in the statement made by 2 of the chairmen of the association

"The government has approved 23 classifications of drugs for us to sell (Key Informant A). The majority of the PPMV stated that "we mainly sell the OTC drugs i.e. those drugs that have gotten their prescription by the carton or the label (Key Informant A, B, D, E & F). Another key informant stated "we sell antacids, analgesics, aontraceptive pills and protection, antiemetics, anthelmintics, anti-malaria, etc." (KII A),

Influence of Patient's Demand For Antibiotics on Choice of Drug Sales

The PPMVs activities and sales of drugs, especially antibiotics, are often influenced by patients' demand for antibiotics. This is because some patients are familiar with certain antibiotics for some health conditions, so they decline any other drug being prescribed for the complaint they make. This was established in the observation made by Informant B as follows:

"Yes, a patient's demand for antibiotics influences our choice of sales" (Key Informant B). The majority (90%) of the PPMVs stated that "Although antibiotics are not on our drug list, we sell the common ones as a form of assistance to the people in cases where they have come to request for a particular one they have been used to. For example, tetracycline – which the

community refers to as a red and yellow capsule. They come to buy it whenever they have diarrhea. So, sometimes, , no matter the persuasion, they will decline any other product you may want to dispense".

"Yes, some customers come to request antibiotics and they will not be willing to get any other drug" (Key Informant B). Some PPMVs stated that "some antibiotics are very common e.g Ampiclox. When customers come to ask for it and you don't have it, they get disappointed and feel you are not competent. So to avoid that, we stock the common antibiotics" (Key Informant A)

Factors Influencing Drug dispensing

The PPMVs elucidated some of the factors that at one point or another influence their dispensing pattern. It emphasises the role of patient demand in their dispensing pattern. Other factors that influenced their dispensing pattern included poor training of some PPMVs, government policies, drugs on stock, socio-economic characteristics of the patient, and manufacturer's factors. According to a majority of the informants:

"Part of the factors that influence our drug dispensing practice include patient's demand (Key Informant A,C& D), lack of thorough training for some PPMVs (Key Informant A,B & E), patient poor knowledge about drugs (Key Informant B,D,F), government policies and drugs on stock" (Key Informant D,E &F).

Discussion

This study included 389 PPMVs from across two Local Government Areas in Ilorin Metropolis (Ilorin South and West). The study showed that the distribution of the PPMVs by sex had more female as compared to male. This study agreed with Abara et al.(2023) who stated that about two-thirds of PPMVs were in Abuja, FCT; and were women. About 61.2 % of the PPMVs fell within the age bracket of 25-40 years and this also aligned with Agha et al. (2022) and Abara et al.(), who equally stated that more than half of PPMVs were under 40 and about four-fifth belonged to the age group 29 years in Lagos and Abuja.

Also, this study established that 52.4% of the PPMVs had secondary education and 45.5 % had tertiary education. However, this is slightly lower and higher than Agha et al. (2022) who stated that most PPMVs (70%) in Lagos had secondary education and about one- fifth of PPMVs had greater

than secondary education. The result also supported Naomi et al. (2015), who stated that many PPMVs have elementary education levels that are greater than average. In Jigawa, the proportion of PPMVs with a university degree was 57%, whereas in Anambra state, it was 14%. Also, only 23.7% of the respondents had less than 5 years of experience. This is however in line with Abara et al. (2023) that stated that a majority of the PPMVs in Abuja had about 5 years of practice experience.

Beyeler et al. (2015) also stated that between 60-70% of PPMVs stock medications they are legally prohibited from selling, such as antibiotics, and provide diagnostic and treatment services that fall outside their legal scope of practice, such as administering injections. This indicates that PPMVs are responsive to customer demand rather than following guidelines, likely due to their lack of formal pharmaceutical training.

The factor that the majority of the PPMVs claimed to influence their antibiotics dispensing and sales was patient demand. This is, however, in line with Adamu Gadanya, Uthman, et al., (2020), who noted that PPMVs stock and sell medications with positive polarity because of the high demand for antibiotics from people in communities and the profit from sales. This highlights the fact that PPMVs is driven to stock and sell antibiotics due to both community demand for the drugs and sales revenue.

Iheoma et al. (2016) also stated that PPMVs may be motivated by financial incentives, such as the potential for higher profits from selling certain drugs, which can lead them to prescribe or dispense medications outside of their legal scope. In addition, weak regulatory enforcement and lack of consistent dispensing among PPMVs contribute to the widespread practice of selling prescription drugs, such as antibiotics, without proper authorisation.

The test of association indicated that there was no statistical significant association between drug dispensing patterns, and education level of PPMVs. It also indicated that there is no statistical significant association between compliance with drug dispensing guidelines and education level of PPMVs. ($\chi^2 = 1.314$, p-value = 0.726).

Conclusion

Therefore, this study showed that patient pressure is a significant factor influencing the drug dispensing pattern of PPMVs, insufficient training and

lack of access to diagnostic tools. Nearly a third of the time, respondents dispensed antibiotics because they couldn't accurately diagnose the illness. Less common reasons for dispensing drugs included economic incentives, peer pressure, lack of awareness about antibiotic resistance, pharmaceutical marketing and regulatory pressure.

Recommendations

It is recommended that there should be community engagement and education campaigns to inform the public about the services of PPMVs ansd their legal boundary. The use of local media and community leaders to disseminate information and enlightenment about the role of PPMVs in society is highy recommended. Regular training of PPMVs with support of simple diagnostic tool to facilitate appropriate dispending must also be priotised.

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CHAPTER TEN

Globalising Education for Sustainable Development: Bridging Global Approaches and Local Realities

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Abstract

The world is committed to achieving sustainable development, and education is central to the transformative change we wish to see. But the road to globalising education has not been smooth, especially in developing countries, like Nigeria, where local realities often conflict with global frameworks and imported models of education. This study critically analysed the apparent disconnect between global education for sustainable development (ESD) strategies and practical implementation in Nigeria. This study examined the theoretical underpinnings of global integration, drawing on policy analysis, comparative education, and historical reforms. It also discussed challenges such as inadequate infrastructure, curriculum misalignment, digital inequality, and cultural resistance that impede effective global integration. Finally, it suggested case-specific strategies to contextualise planetary educational aspirations without diluting its principled content. Bridging this gap would require a hybrid model that infuses global competencies into local knowledge systems, such as support for experiential learning and education, ensuring that education systems in Nigeria are globally relevant and socially and culturally sustainable.

Keywords: Glocalising, Education, Sustainable Development, Local Realities.

Introduction

The relationship between education and development has been established such that education is now internationally accepted as a key development index, and it is in recognition of this importance that governments all over the world have made commitments in their countries' educational policies for their citizens to have access to education (Odukoya, 2009). Castle in Adeyinka (2012) defined development as "a situation wherein man himself

becomes both the object and the subject of his own improvement, not merely an instrument in a process imposed from above and from without." Education policy issues continue to be a critical concern in developing countries in Africa and a critical tool for development (Imam, 2012). When it comes to education and development, Nigeria's philosophy since independence has been anything but static. At independence, Nigeria's foremost educational objective was to train its nationals to take over its civil service. Educational policy at independence was most concerned with using schools to develop manpower for economic development and Africanization of the civil service (Woolman, 2001). Many changes have been made to education policy over the years in compliance with the changing educational policies across the World. Education for Sustainable Development (ESD) originated in the late 20th century from increasing recognition that the education system must tackle environmental, social and economic issues. Its origins are in the 1972 Stockholm Conference and were more fleshed out in the 1987 Brundtland Report, which popularized the term "sustainable development." These ideas came together at the 1992 Earth Summit and acknowledged education as being central to sustainable development. Global goals, such as the UN Decade of ESD (2005–2014) and SDG 4.7, serve as mandates to incorporate sustainability, global citizenship, and cultural awareness into education.

The world has shown minimal progress on the 17 Sustainable Development Goals (SDGs) despite this progress, signalling the need for stronger locally rooted actions. The need to envision and realise more sustainable futures for people and the planet has become increasingly urgent in recent years, as evident in the limited progress the world has made in achieving the 17 sustainable development goals (SDGs) adopted by United Nations member states in 2015 and which are intended as an holistic framework for realising sustainable futures by 2030 (UN, 2015). The evolution of the Nigerian education system has long been shaped by colonialism and post-independence, with early emphasis on administrative training rather than technical or environmental education (Tijani et al., 2009). Strategies, like the 1977 National Policy on Education, attempted to be aligned with development goals, but were largely driven by donour priorities, lacked continuity, and were poorly funded. Disparities persist between global sustainability concepts and local contextual realities, such as antiquated curricula, underfunding, and socio-political instability.

Nigeria accounts for 15% of the global figure, which is about 10.5 million children aged 5-14 years old. It is the first time the World Bank has fixed this 10% figure, and it says Nigeria is the world capital of out-of-school children. (UNESCO). The country still under-invest in education, with just 7.9% for education in 2024, well below the national recommendation of UNESCO itself of 15- 20%.

This gap between policy intent and implementation underscores the need for historically informed reforms. This article examined global ESD discourse and situates it within the context of Nigeria's educational progress, delineating barriers and opportunities for a more inclusive and sustainability-oriented education practice in the country.

Statement of the Problem

Although there have been improvements towards global Environmental Sustainable Development (ESD), it may be noted that Nigeria has failed in the implementation of ESD issues as global goals. Nigeria's goals had long been at divergence with the international goals since the 2005 World Summit on Social Development held in Geneva, which had agreed in principle to take action for sustainable development at the international level. Nigeria's education system in the post-independence era was centred on the need for trained manpower as opposed to sustainability, and in most cases, colonial models inherited overtly disregarded knowledge of the indigenous people. Inadequate teacher training and professional development represent significant challenges within the Nigerian education system, impeding the quality of teaching and limiting the overall effectiveness of the education system (Obiakor & Okoli, 2019). Continued under-funding, policy instability and political interference also constrain the incorporation of ESD into curricula and teacher training. Addressing these gaps would require a confrontation with the historical foundations of the problem and modifying global models to Nigeria's socio-cultural realities.

Historical context is vital to think through reforms that might work. This study illustrated enabling evidence of how Nigeria's education policies have been shaped by a complex interplay of colonial legacies, global influences, and internal dynamics. It promoted a "glocal" perspective that combines global ESD ideals with local contexts, recognising the importance of

indigenous knowledge and significance of culture. It provided learning that can really help steer other post-colonial nations with a similar strategy to align global mandates to local needs.

Aim and Objectives

This study revisited the historical dynamics between global ESD ideals and education policy in Nigeria. Its objectives were to:

1. explore the historical trajectory of global ESD frameworks;
2. chart Nigeria's engagement with these frameworks;
3. hypothesise historically attuned strategies for bridging global and local education gaps; and
4. Propose pathways that internalise indigenous knowledge, dismantle systemic barriers and localise ESD

Literature Review: Conceptual and Theoretical Framework

The study applied the historical and critical theories to understand the globalisation of ESD and its local pathology in Nigeria.

Key Concepts

Education: A wide-ranging, lifelong process of gaining knowledge and values, formal and informal. Gandhi, Durkheim and others defined it as essentially holistic, socialising. Aristotle: "Education is the creation of sound mind in a sound body."Herbert Spencer: "Education is complete living."

Globalisation of Education: Overseas, the identity of education systems and ideals that span ideals and policy on the international stages.

ESD: Provides learners with the skills and values needed to tackle global issues such as climate change and inequity. UNESCO views ESD as a key to unlocking progress towards the global development goals, equipping people of all ages with the tools to address challenges like climate change, biodiversity loss, and inequality.

Localisation In Education: Adapting and contextualising education models to fit local frameworks, cultures, needs, and knowledge systems. The goal is to create an educational framework that is tailored to the unique needs of a

specific region or community, ensuring that learning materials are relevant and meaningful for students.

Theoretical Approaches:

A. Historical Institutionalism

✓ Looks at how historical decisions and institutional trajectories shape present-day education policies and make it difficult for them to adjust accordingly to new global trends.

B. Postcolonial Theory

✓ Critiques the long-lasting impact of colonialism, arguing that Western knowledge systems have been imposed over indigenous ones and urges for decolonisation in education.

C. The Globalisation vs. Localisation Discourse in Historical Context:

✓ The tension between global models and local needs is an old one from colonial education to contemporary development goals. Grasping this tension is important for situating ESD in Nigeria as it stands today.

A Historical Perspective on Global ESD Agendas

Key milestones and changing global discourses have driven ESD forward. This history matters because it reveals the extent of the disconnect between global frameworks, such as the Paris Agreement, and local implementation, particularly in countries like Nigeria.

Timeline of Key Milestones:

- Stockholm Conference (1972): The United Nations Conference on the Human Environment recognised the environmental crisis and proposed Environmental education, which laid the foundation for the introduction of sustainability in education.
- Brundtland Report (1987): Provided a definition of sustainable development and emphasised education as a key to realise a balance between growth, preservation and equity.
- Earth Summit, Rio de Janeiro (1992): The United Nations Conference on Environment and Development (UNCED) adopted Agenda 21, where education was established as one of the critical vehicle for

sustainability as is particularly addressed in Chapter 36 on public awareness and training.

- UN Decade of Education for Sustainable Development (2005–2014): An initiative launched by UNESCO to build sustainable thinking, acting and living in education but with region based influences.
- Sustainable Development Goal 4.7 (adopted in 2015): Of many international commitments made by countries, SDG 4.7 was to ensure that all learners acquire knowledge and skills needed to promote sustainable development, including sustainable development of global citizenship and gender equality by 2030. (UNESCO)
- Shifting Global Narratives about education and sustainability: The world narrative has changed from the need to educate for the environment to the realisation that education itself is essential to address issues facing the world. With the 21st century skills approaches, there is now an emphasis on critical thinking skills, participatory learning and cultural relevance in the classrooms.

Nigeria's Education Development and Response to ESD

With over 350 different ethnic groups speaking more than 500 languages, Nigeria's diverse population has specific challenges when it comes to localising ESD. In this section, we discuss Nigeria's colonial and post-colonial educational legacies, engagement with international sustainability frameworks and ESD implementation barriers.

Colonial and Post-Colonial Education Policies

- The introduction of formal education in Nigeria was mainly through Christian missionaries who incorporated Western values at the expense of indigenous knowledge. The colonial education system emphasised developing clerks not individuals.
- *National Policy on Education (1977 and Revised):* The post-independence policies were self-reliant, but adopted, at least, to the extent of being a replicate of foreign policies and did not leave sufficient room for sustainable growth or global citizenship.
- MDGs/SDGs: The t two frameworks have measurable targets of 2000, Nigeria is still taming to universal basic education and gender equity.

Nigeria's pledge to Education-for-Sustainable-Development (ESD) had not been shattered after SDG 4.7 was adopted in 2015, but its implementation was selective and inconsistent.

- ESD-related curricula: Initiatives to mainstream sustainability themes into curricula are disparate and underfunded, and there is a yawning gap between curriculum development and the realities of classroom practice. This article examined these structural and ideological discrepancies that have troubled ESD integration in Nigeria.

Sustainable Localisation of Global ESD: Strategies

Algorithms to Measure the Impact of Historically Informed Curricular Reforms

Curricula reforms must go beyond simply introducing global concepts into textbooks. Traditions, demonstrating how previous implementation of improvement illustrates reform that involves teachers, reflects their values, and suits a given cultural context (sometimes what worked better were informal or relaxed surroundings which promote learning more effectively than the normal classroom analogically speaking environment). A contextualised ESD curriculum needs to integrate global competencies (e.g. climate literacy, global citizenship) with local knowledge systems, culture, languages and practices. UNESCO says that a language which is perfectly suitable for literacy must be known to both the learners and the teachers, and it should also be used as a communication medium (UNESCO 1992:23).

Simply put, this is the institutional memory and kneading of policies.

There are also lessons to learn from successful programmes that have come before. For example, the Agricultural Science uses of the 1980s or community based adult literacy programmes which have proven frameworks that can be invaluable in the broadening of ESD. In the 1980s, Nigeria was flooded with agricultural research programmes like Structural Adjustment Programme (SAP) aimed at transforming agriculture for commercial production and food self-sufficiency, and buildings up to research institutes and Directorate for Food, Roads and Rural Infrastructure (DFRRI). Also, during this period, the National Accelerated Food Production Project (NAFPP) was founded in 1973; Nigerian Agricultural and Cooperative Bank (NACB) was also founded in 1973 and the Integrated Agricultural

Development Projects (ADPs) and the National Grains Reserve Programme(NGRP) were introduced in 1975. The NAFPP was created as the acceleration of major staple crops production. There were also National Programmes for Grains and Root Crops Cultivation, again, to increase the production of its mandated crops. ((Akinboyo, O. 2008)

Such a dedicated initiative could help monitor and hold accountable the advances made on ESD, and maintain continuity of knowledge and efforts associated to ESD, despite the general shifts of political cycles.

Community Engagement

Community engagement involves the active participation of community members, parents/ guardians, and local organisations and stakeholders in the educational process. It is a multidisciplinary model that considers the unique and strength of the entire community working together to aid in the improvement of education. (Jegede & Ogunleye, 2021). The historical neglect of local voices at Table of Education Policy has resulted in a top-down approach which most of the time is far from ground reality. This trend needs to be reversed for sustainable localisation of ESD. More relevant and effective educational practices can also emerge from these shared decisions that are made with insight, cultural perspectives and local expertise. (Amos,, 2024). Many ESD policies should be co-developed with teachers, parents, students, and community leaders, drawing from participatory traditions of town-hall meetings and local governance systems. Such inclusion garners ownership and aligns reforms with socio-cultural mores and could enhance student learning achievements through a supportive and nurturing environment. Then, by stepping into roles as mentors or helping plan educational events, community members put additional resources and experiences as well as role models at students' disposal. Moreover, community engagement enhances the school-family bond. This might result in an active parental involvement, improved communication and a better support for student learning at home (Obiakor & Okoli, 2019).

Historical Lessons and Strategic Directions

Lessons learnt from previous reforms in education should be used in localising ESD in Nigeria. Nigeria's post-independence educational reforms have fluctuated between aspirations for global relevance and the imperatives of national identity. Historical evidence indicates pathways for aligning global

ESD objectives with local contexts through localised curricula and inclusive policy development. In the quest for rapid development and in pursuance of meaningful educational development, the Western Regional Government gave education highest priority.

Nigerian Educational Policy from Colonial Rule to Post Independence (1914-1960 and Now)

The 1925 memorandum regarding educational policy for British Tropical Africa initiated by the British colonial government resulted in the 1926 Education Ordinance. This ordinance came on the heels of the Phelps-Stroke Commission's recommendations to improve education efficiency and shut down unregulated schools. It called for increased investment in education, formal education suited to local conditions, stresses on vernacular studies, women's education, moral training, etc. It was the first policy to incorporate local content and it steered education in Nigeria from 1926 to 1945.

The 1948 Education Ordinance

The 1948 Ordinance, enacted through Sir Arthur Richard subsequent to several reports and the 1946 educational plan administered education centrally, supported regional education boards, privatisation, and enhanced incentives. It also framed grants assessment for mission schools, decentralised educational governance.

The 1952 Education Ordinance

As the quest for self-governance became louder in Nigeria, the McPherson Constitution of 1951, which consolidated Nigeria into three regions, emerged. Thus, the Education Ordinance of 1952 granted the various regions the power to develop their own educational plans and policies, and ultimately led to the dissolution of the Colonial Education Board.

The Regional Education Laws (1955 – 1957)

The 1954 Federal Constitution granted each region the authority to draft its educational laws, resulting in the enactment of regional education laws such as the Western (1955) and Eastern (1956) templates, as well as the Northern (1957) region and the Lagos Education Ordinance (1957).

The Ashby Report (1959)

The Ashby Commission was constituted to examine Nigeria's manpower needs between 1960-1980 stated. It came with the resolution that more primary and secondary schools are required to promote socio-economic growth of the nation and socio-economic development of the individual and that the decentralisation of authority would be maintained as the dominant pattern of education administration until Independence in 1960.

National Educational Policy of Independence (1960–1979)

After independence, Nigeria created 19 states by 1976, each with its own education laws. The National Policy on Education (NPE) -1977, was the first indigenous policy and its main objective was to bring about unity and national integration through education.

The Education Laws of the School Republic (1979–1999)

Based on military hegemony, the second republic (1979) of Nigeria was inaugurated under another constitution which placed education within the ambit of the concurrent legislative list. In 1976, a UPE (Universal Primary Education) policy was instituted with a target of increasing enrolment but this was short-lived ending in 1981 when monetary challenges forced the government to cut expenditure; thus facing striking teachers and declining standards. UBE was introduced in 1999, replacing UPE to provide equal educational opportunities.

So far, Nigeria’s educational policy has been progressively adapted to the colonial policies instead of building new, local frameworks.

Conclusion/Recommendation

The study mapped the evolution of global ESD, from the Stockholm Conference (1972) to SDG 4.7 (2015), capturing evidence of increasing integration of sustainability perspectives into education throughout the globe. Yet, Nigeria’s case, like many other countries, demonstrates a wide disparity between such global aspirations and national/local action, mainly owing to the colonial legacies of education, socio-political instability, poor funding and infrastructural hindrances.

Historical evidence suggests that Nigeria's attempts to adopt international norms have rarely been genuine, and where they have, they have fallen well short of the realities of cultural and socio-economic conditions in Nigeria. The

study highlighted that attempts to import models from around the world without accounting for local contexts regarding historical legacies, indigenous knowledge, and local values are largely ineffective in moving reforms forward.

This makes bridging global sustainability aspirations with Nigeria's history and culture very important. This necessitates participatory and historically cognizant reform with boots on the ground engaging local communities, educators, and policymakers. By analysing the historical and global context what has worked and what has not, Nigeria has the capacity to not only produce a globally competitive education system, but one which is also grounded in local culture, essence, needs, and relevance, thereby creating a more effective, appropriate, eco-friendly future of education.

Recommendations

1. Revive Technical and Vocational Training

Technical and vocational education schools should be upgraded and included in the basic education system so that students receive job-ready skills, while promoting self-reliance and entrepreneurship and reducing youth unemployment.

2. Re-establishment of Teachers' Training Colleges

Reintroducing Teachers' Training Colleges will strengthen foundational education, especially in under-served communities. These institutions produced competent, community-rooted educators who understood local realities. Their return would promote inclusive and contextually relevant teaching, a core element of ESD.

3. Reflect Indigenous Arts and Crafts in the Curricula

Integrate indigenous knowledge systems (such as pottery, weaving, wood carving, etc.) within school curricula to promote cultural sustainability, creativity, and respect for local traditions.

4. Agricultural education should be strengthened

Focus on practical farming programs to improve agricultural education using the existing school farms to reconnect students with sustainable food practices, traditional farming techniques, and environmental stewardship.

5. Localise School Curricula

Develop a curriculum which integrates Nigeria's social, cultural, economic, and ecological context into it and which makes global goals including ESD relevant and sustainable for local communities.

6. Promote Inclusive Education

Nigeria should adopt flexible and inclusive education policy. Expand initiative by encouraging open and Distance Learning, vocational schools, and community learning centers.

Revising Academic Policies for a More Inclusive and Sustainable Education

7. Professional Experience for Postgraduate Admission

Take on an inclusive admission structure, acceptance of professional experience as a portion of postgraduate entrance, validated informal learning, empowering each authority so you can achieve a non-linear-wound scholastic course.

8. Ease O'Level Requirements for Postgraduate Degrees

Scrap outdated policies and rules like insist on O'Levels for postgraduate study, thereby, promoting more inclusive and flexible pathways for adult learners.

9. Develop Alternative Ways for Non-Traditional Students to Gain Admission

Increase access for adults and non-traditional students through relaxed pathways (competency-based assessments, portfolio-based admissions) that expand educational opportunities for those who may not fit the traditional model and will support both the working learner and the goals of employers to prepare current and future employees for the future of work.

10. Open and Distance Learning Platforms

Promote open and distance learning (ODL) to develop education access for marginalized groups and working adults, who could benefit from ODL as it

provides inclusive education and allows marginalised groups to overcome structural barriers.

11. Embed Experiential Learning into the Curriculum

Scale open academic models that embed real-life experience, community engagement and local knowledge in the formal curriculum, aligning top-down education requirements with local realities.

12. Adopt a national admission policy review and reform process for SDG alignment

National education policy and practices should align with SDG 4, including components such as equitable access to affordable technical, vocational and tertiary education, and considerations for integrating education for sustainable development, among others.

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CHAPTER ELEVEN

Effectiveness of Team Building Activities in Enhancing Trust and Transparency within Virtual Teams

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Abstract

This quantitative study investigated the effectiveness of team-building activities in enhancing trust and transparency within virtual teams, a crucial area given the increasing prevalence of remote work. It addressed the challenges of fostering cohesion in geographically dispersed teams reliant on digital communication. Using surveys and assessments, the research measured the impact of interventions such as virtual workshops and collaborative tasks on key metrics: psychological safety, communication clarity, and accountability. The study sought to measure cognitive and affective trust among virtual team members, evaluate the impact of specific team-building activities on perceived transparency, and identify the most effective activities for enhancing trust. It also examined the correlation between the frequency of these activities and the levels of trust and transparency, while considering the influence of demographic factors. The outcomes of this research would inform strategies to optimise team dynamics, improve decision-making, and mitigate conflicts within virtual teams. The evidence-based findings aimed to guide organisations in developing comprehensive frameworks for virtual team collaboration and performance optimisation. This study would contribute to both academic discourse and practical application in organisational settings, offering insights into strategies that could enhance team performance, collaboration, and productivity in remote work environments.

Keywords: Virtual Teams, Team-Building Activities, Trust, Transparency

Introduction

The rise of globalisation and advancements in technology have revolutionised organisational operations, leading to the widespread adoption of virtual teams. These teams, characterised by geographic dispersion and reliance on digital

communication platforms, offer numerous benefits such as flexibility, cost savings, and access to a diverse talent pool (McEwan *et al*., 2017; Hoch & Kozlowski, 2014). However, the absence of physical interactions introduces challenges in fostering trust and transparency - two critical components for effective teamwork.

Trust in virtual teams is categorised into cognitive trust, derived from perceptions of competence and reliability, and affective trust, which evolves from emotional bonds and interpersonal rapport (Kanawattanachai & Yoo, 2002). Transparency, on the other hand, ensures that all team members have access to relevant information, enabling informed decision-making and accountability (Palanski *et al*., 2011). In virtual environments, asynchronous communication, lack of non-verbal cues, and potential information silos often hinder these elements (Erez *et al*., 2023).

Team-building activities have traditionally been used to strengthen relationships and improve collaboration in co-located teams (Tannenbaum *et al*., 2012). In virtual settings, these activities must be adapted to address unique challenges such as isolation, communication barriers, and cultural differences (Sivunen & Hakonen, 2011). Despite their potential benefits, there is limited research on the effectiveness of team-building activities in enhancing trust and transparency within virtual teams. This study aimed at filling this gap by investigating how team-building activities impact these critical dimensions.

Literature Review

Virtual teams represent a paradigm shift in organisational collaboration. Unlike traditional co-located groups, virtual teams rely heavily on digital platforms for communication and collaboration. While this model offers flexibility and scalability, it also introduces complexities in fostering interpersonal cohesion (Ferreira & Rodrigues, 2023; Morrison-Smith & Ruiz, 2020). In these settings, trust is a critical construct that underpins successful collaboration. It manifests in two distinct dimensions: cognitive trust, which is derived from perceptions of competency and reliability, and affective trust, which evolves from emotional bonds and interpersonal rapport (Breuer *et al*., 2016; Ford *et al*., 2017).

Transparency in virtual environments further contributes to team effectiveness by ensuring that information is openly shared and accessible, thereby

facilitating informed decision-making and accountability (Howard *et al*., 2020). The absence of face-to-face interactions often impedes natural communication channels, making deliberate strategies for maintaining clarity and openness imperative (Marlow *et al*., 2017). Against this backdrop, team building activities emerge as instrumental interventions designed to mitigate the challenges posed by digital collaboration. These activities, ranging from interactive virtual workshops to collaborative problem-solving simulations, seek to create opportunities for shared experiences and authentic connections, ultimately reinforcing both trust and transparency within virtual teams (Hertel *et al*., 2005; Sivunen & Hakonen, 2011). Collectively, these elements underscore the transformative potential of targeted team building approaches in harnessing the full collaborative capacity of distributed workforces.

The increasing prevalence of virtual teams as a dominant mode of collaboration in today's globalised and technologically advanced organisational landscape necessitates a deeper understanding of the mechanisms that foster effective team dynamics. Trust and transparency are critical components of this dynamic; they are essential for overcoming the inherent challenges of reduced physical presence and the limitations of digital communication platforms (Altschuller & Benbunan-Fich, 2010; Hertel *et al*., 2005).

Trust in Virtual Teams

Trust is foundational for effective teamwork. In contemporary organisational settings, particularly within virtual teams, trust facilitates the development of resilient social bonds despite the absence of face-to-face interactions (Wilson *et al*., 2006). Scholarly literature often conceptualises trust in teams along two interrelated dimensions: **cognitive-based trust** and **affective-based trust.** Cognitive trust is built on perceptions of competence and reliability (Kanawattanachai & Yoo, 2002), while affective trust stems from emotional bonds formed through positive interactions (Breuer *et al*., 2016). In virtual settings, the absence of face-to-face interactions often delays or inhibits the development of both types of trust (Jarvenpaa & Leidner, 1999). Breuer *et al*. (2016) further highlighted that the absence of non-verbal communication in virtual environments slows down the formation of affective trust which relies on emotional connections and personal rapport to take effect. In the absence of facial expressions, body language, and immediate empathetic responses,

team members may develop a cautious approach to collaboration, resulting in a slower and less robust trust-building process. The cumulative effect of these challenges highlights the need for deliberate interventions, such as tailored team building activities, to bridge the interpersonal gap and foster a healthier trust continuum in virtual teams.

Transparency in Virtual Teams

Transparency in a team context is defined as the consistent and availability of relevant information that empowers team members to make informed decisions and fosters accountability within the group (Edmondson, 1999). Studies have shown that transparency transcends mere data sharing. Other important factors like the clarity and accessibility of the process, the rationale behind decisions, the timeliness of project progress updates (Edmondson, 1999; Palanski *et al*., 2011) are equally very key. By ensuring that critical information is accessible, teams can align their efforts more effectively, anticipate challenges, and respond collaboratively to emerging situations (Mesmer-Magnus & DeChurch, 2009).

Environments with these features improve the process of decision-making by reducing uncertainties and preventing information silos, which are some of the common issues with virtual settings. Furthermore, transparency promotes accountability as it enables individuals to understand not only what decisions are made but also how these decisions impact overall team performance (Rawlins, 2008). In virtual environments, maintaining transparency requires deliberate strategies such as regular updates, clear documentation, and collaborative tools that facilitate information sharing (Leonardi & Contractor, 2018). Without these practices, misunderstandings can arise, negatively impacting team cohesion (Marlow *et al*., 2017).

Role of Team Building Activities

Team building activities are structured interventions aimed at improving interpersonal relationships and team cohesion. Tailored team building activities are designed to directly address the challenges of trust and transparency within virtual teams. By incorporating interactive elements such as virtual workshops, escape rooms, and collaborative group simulations, these structured interventions provide team members with opportunities for reciprocal interactions that mirror the spontaneity and depth of face-to-face engagements (Lansing, Nikolaidis, & Cosier, 2017). Such activities foster

cognitive trust by enabling individuals to assess each other's reliability and competence through structured, observable tasks. Simultaneously, they cultivate affective trust by generating shared experiences and emotional bonds that are typically underdeveloped in purely asynchronous digital interactions (Sivunen & Hakonen, 2011).

Moreover, these activities enhance transparency by establishing standardised protocols for information sharing and real-time feedback, thereby reducing the occurrence of communication silos and ensuring that critical information is accessible to all team members (Gibbs, Maznevski, & Sung, 2017). The integration of structured team building in virtual settings thereby provides a dual benefit: it enriches the communicative quality of digital interactions and creates a stable foundation for trust development that is both rationally and emotionally grounded.

Research Methodology

This study adopted a quantitative research design rooted in a systematic method to empirically examine the effects of team building activities on trust and transparency within virtual teams. A quantitative approach is most appropriate for this investigation because it allows for the measurement of abstract constructs through standardised instruments, the testing of hypotheses, and the establishment of statistically significant relationships among variables (Creswell & Creswell, 2017).

The research is structured as a cross-sectional study using a survey methodology, which captured data from virtual team members at a single point in time. Data was collected using validated questionnaires administered to employees across multiple organisations that employ virtual teams. The survey measured respondents' perceptions of interpersonal trust, the clarity and openness of information exchange (transparency), and the perceived effectiveness of various team building activities.

The research population for this study comprised individuals who actively participated in virtual teams within organisations operating in today's global and digitally connected economy. Virtual teams are defined as groups of employees who collaborate toward shared objectives while being geographically dispersed and relying primarily on digital communication platforms. To capture the nuances of virtual team dynamics, the population included both team members and their leaders, ensuring a comprehensive

understanding of how trust and transparency are cultivated through team building interventions. Participants were drawn from a variety of industries such as technology, consulting, and professional services where the adoption of virtual work settings is prevalent.

Data Presentation and Analysis

In measuring the level of cognitive and affective trust among virtual team members, the results indicated that team-building activities significantly enhance both cognitive and affective trust among virtual team members. Respondents rated their levels of trust and transparency within virtual teams as moderately high, with mean scores of 3.8 (SD = 0.6) for trust and 3.6 (SD = 0.7) for transparency on a 5-point Likert scale. The perceived effectiveness of team-building activities was also rated positively, with a mean score of 4.1 (SD = 0.5). These findings suggest that team members generally perceive team-building interventions as beneficial for fostering collaboration.

Variable	Mean	Standard Deviation (SD)	Correlation Coefficient (r)	p-value
Cognitive Trust	3.7	0.6	0.68 (with Team-Building)	< 0.001
Affective Trust	3.9	0.7		
Transparency	3.6	0.7	0.62 (with Team-Building)	< 0.001
Team-Building Activities	4.1	0.5	-	-

In evaluating the impact of team-building activities (e.g., virtual workshops, collaborative tasks) on perceived transparency of communication, this table highlights the statistically significant differences in perceived transparency between those who participated in virtual workshops and collaborative tasks versus those who did not. The lower p-values indicate a strong likelihood that these activities positively influence transparency. Interactive collaborative activities, such as virtual escape rooms and group simulations, were found to

be more effective than passive activities like webinars as they foster emotional bonds among team members. These results align with previous research suggesting that shared experiences are instrumental in building affective trust (Kanawattanachai & Yoo, 2002).

Team-Building Activity	Mean (Participants)	SD (Participants)	Mean (non-participants)	SD (non-participants)	p-value
Virtual Workshops	4.2	0.5	3.3	0.6	< 0.001
Collaborative Tasks	4.0	0.6	3.5	0.7	< 0.001

Moreover, the study highlighted a positive correlation between the frequency of team-building activities and perceived transparency. The Pearson correlation coefficients (r) and p-values indicate statistically significant positive relationships between the frequency of team-building activities on both trust and transparency. Regular engagement in structured activities ensures consistent communication flow and reinforces mutual understanding among team members. This suggests that more frequent team-building efforts are associated with higher levels of trust and transparency within virtual teams. This supports existing literature emphasising the role of transparency in improving decision-making processes within virtual teams (Palanski *et al*., 2011).

Variable	Pearson's (r)	p-value	Interpretation
Trust	0.68	< 0.001	Strong positive correlation
Transparency	0.62	< 0.001	Moderate to strong positive correlation

Despite these positive outcomes, challenges remain. Passive or individual-focused activities such as webinars were less effective in enhancing trust or transparency compared to interactive formats. This suggests that active participation is crucial for achieving meaningful outcomes.

Conclusion

This study provided evidence that team-building activities are effective tools for enhancing trust and transparency within virtual teams. By fostering cognitive trust through competence-based tasks and affective trust through shared experiences, these activities address key challenges associated with remote collaboration.

The findings emphasised the need for organisations to invest in regular and interactive team building initiatives tailored to their team's demographic composition. Such interventions not only improve interpersonal relationships, but they also create a transparent work culture conducive to collaboration and innovation.

As remote work continues to grow globally, understanding how to optimise virtual team dynamics becomes increasingly important. Future research should explore additional variables such as cultural diversity or technological proficiency to further refine strategies for managing virtual teams effectively.

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CHAPTER TWELVE

Glocalisation of Africa's Untapped Heritage from Primary to Tertiary Education: Community Service of Higher Education

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Abstract

Higher education is the bridge that connects town and gown; they delve into the corners to turn ideas into opportunities. Higher education instruction should, therefore, encourage pupils to experiment. To preserve the slowly deteriorating cultural values and increase the chances of cooperative inquiry-based learning, creative problem-solving, and creative activities, the GLOCALISE strategy, which combines global and local values, should be employed. When youngsters are not exposed to a culture, it dies too soon. As a result, all educational levels should incorporate the idea of glocalisation into their curricula. At the primary level, this should take the form of a role-playing or storytelling approach; at the secondary level, it should be project-based; and at the tertiary level, it should be problem-solving. Each level's various concepts ought to be connected to a proverb, idiom, artefact, antique, custom, or culture. Contextualised learning makes a lot of sense; it is enjoyable for students and fosters critical thinking and teamwork. Therefore, this paper examined how the GLOCALISE strategy is using crowdsourcing to explore some African cultural heritages globally (locally and globally) while creating tools for teaching and student involvement that are available to educators, parents, and other interested stakeholders. GLOCAL professionals update and validate the curriculum, assessment, and instructional materials. It is envisaged that this strategy will foster the creative minds of Africans and turn unexplored African history into invaluable gems for the world.

Keywords: Glocalisation, Unmined Heritage, Community Service, Higher Education

Introduction

When the colonial masters came to Africa, they gave and took. Among what they gave was cultural erosion, while what they took, they claimed its birth right. Adaptation of what they termed barbaric in our culture became the stepping stone of their civilisation in Medicine, Information and Communication Technologies (ICTs), Computing Systems (CS) and more. *Aroko*(hieroglyphics), the African ICT and CS, as derived from *Ifa* Binary Systems in Yoruba culture in Africa, are typical examples. The premise of this paper though is not to cry over spilt milk, but to reposition our cultural heritage in the global stage through Glocalisation. To Glocalise is to dig deep into our rich cultural heritage to develop new or enrich existing areas of science and technology. A culture that is hidden from children goes into extinction too soon.

Globally, some values are universal while locally some are specific to different cultures and traditions. To synchronise these values and bring out the uniqueness in them, the term GLOCAL refers to a blend of global and local values, ideals, resources, games, play, riddles, poems, proverbs, hieroglyphics, stories, songs, arts and antiques for learning concepts in universal and specific contexts. This is an effort to connect the slowly vanishing old African cultural values with the social and educational ideals of today. This calls for increasing involvement by creating a network of educators, subject-matter experts, local and cultural specialists, government organisations, parents, school administrators, and other interested parties to discuss ways to increase learning opportunities for students while promoting the development of community values.

Glocalise approach embraces cultural phenomena and tools to triangulate ideas in the vast and culturally diverse African setting. Key components of the learner-centered contextualised learning paradigm are inquiry-based learning, learner engagement, and learner-context. It encourages students to actively engage in their education and places a strong emphasis on placing learning within their life experiences and immediate surroundings. It requires student participation through practical exercises to guarantee that students acquire knowledge of scientific ideas and transform them into problem-solvers. In order for students and teachers to work together on problem-solving and inquiry-based projects and become creators of novel practices and

methodologies, it is implied that pedagogical techniques and practices are established creatively and flexibly.

In education, glocalisation refers to the use of a learner-centered approach to explore local context to teach global content while producing new and outcome-based glocal (Global and Local) content resources. Examples of this include refining the products of cultural practices and creating local versions of modern technologies, expanding the inventive scientific discoveries from indigenous cultural heritages, and proposing laws based on cultural insights.

It is, therefore, essential to incorporate the idea of glocalisation into the curriculum at all educational levels, enhancing it with imaginative exercises that address pressing issues in our local setting. Our setting becomes global, and our education becomes meaningfully outcome-based when students acquire and use their abilities to improve our immediate surroundings. Teachers and students both become creative innovators rather than merely polite consumers. Our goal at glocalise is to learn about the global scene to create a local scenario and promote on the glocal arena.

Anchored instruction, also known as situated cognition learning, active learning, discovery learning, constructivism, cooperative/collaborative learning, connectivism, experiential learning, design-thinking, and many more theories support GLOCALISE. Adedokun-Shittu, AbdulKabir and Nuhu, (2018) succinctly described that discovery learning is inquiry-based approach that encourages learning by doing, through observation and organised activities that is guided or unguided by a teacher in a way that makes it viable for problem-solving. Constructing new knowledge through learning activities revolving round student experiences, dialogue, doing and observing is promoted by active learning model. Cooperative/collaborative learning develops support skills in students rather than competitive skills. Connectivism is a theoretical construct for learning in the digital era focused on creating connections and networks to facilitate learning among diverse people and communities for cooperative, peer and team collaborative learning. Experiential and design-thinking models adopt problem/project-based learning approach to ensure students experience learning by doing and tinker as they apply theories and concepts in real life problem-solving situations.

Constructive review and practical implementation of these theories in real life situations can produce fruitful learning outcomes in students while also

studying phenomenon, drawing conclusions, confirming or rejecting prior notions and making observations that may subsequently develop into novel concepts and fresh models. Global norms encourage the discovery of new information, while Africa's poorer nations are still confined to repeating what has already been discovered. It is time to stop our next generation from starting from scratch. Instead, let us take a big, brave step toward producing knowledge while politely absorbing that which has already been produced. This can begin when we instill in our kids the values of observation, inquiry, problem-solving, teamwork, and solving issues on their own instead of just consuming old stories that were created by the great minds of the past. We need to start producing the brightest minds of our own and the next generation!

How exploratory will it be to teach encryption, image representation, programming by exploring *Aroko* (African hieroglyphics), permutation and combination through *ayo olopon*, *lanka lanka* (hopscotch) for programming and algorithmic functions, *odu ifa* and *ayo olopon* for teaching binary representation, create unique audio clips with musical instruments such as *ilu* (drum), apala, fuji, dundun, program a virtual human to perform dance moves (*bata, gelede*) through trigonometric functions, counting rhythm beats "*Eni bi eni, eji bi eji, eta nta gba, erin woroko*,.. to teach elementary counting?" Consider using lanka-lanka (hop-scotch) to teach "addition"—in fact, the entire BODMAS—for addition and subtraction, then tente, tinko, and okoto tita to teach multiplication and division. Consider sayings that relate to ideas in biology, chemistry, or physics. '*Laalaa to roke, ile lo nbo*' - a Yoruba proverb explaining perfectly the 'Law of Gravity'. *Yoo bale, yoo bale ni labalaba fii wo igbo* – an incantation line describing the concept of weight. The Archemedes principle of physics, Iromi to n jo lori omi, onilu re wa nisale odo, describes the upthrust that occurs when a body is submerged in a fluid. *Okere to gun ori ope ree le tente, oju to ile oju to oko* – a squirrel that glances from atop a palm tree, it could see far and wide - (Satellite Communication), *eegun atiro wole, eeyan atiro jade; tani komo pe eegun atiro to wole ni eeyan atiro to jade* - a limping masquerade enters, then a limping person exits, isn't it obvious that it's the limping person that is disguised as the masquerade - Quadratic equation.

All these are in our tradition; we need not wait for an Oyinbo man to call it ETHNOCOMPUTING for us before we adopt it. Dr Ron Eglash came up with

the concept of Ethnocomputing or culturally situated learning to get students to learn to solve problems in creative ways through the use of Culturally Situated Design Tools (CSDT). The CSDTs are web-based software applications that allow students to create stimulations of cultural arts (Eglash, et.al., 2006).

Through this glocalise approach, students will be involved in several in-depth projects to demonstrate application of several scientific and computing concepts in real-life situations. These would ultimately allow them to utilise appropriate tools and methods to carry out in-depth research and gain insights into developing algorithms to solve real- life problems while also reviving our lost cultural glory.

The Glocalise Teaching Methodology

> *The old model of learning facts passively and then reciting them out of context is no longer enough to prepare students in today's world. Solving complex problems involves fundamental skills (reading, writing, math) along with other 21st century competencies such as teamwork, time management and the use of digital tools. Realinfluencer, (2019).*

Glocalise has benefitted from the 21st century teaching methodologies, which are summarised below, and which are revolutionalising learning environments world over while also promoting innovative approaches by educators.

Flipped Learning

Flipped learning or classroom is a reverse pedagogical approach where the primary educational materials are studied by students at home, which are then further discussed in class to optimise time spent on a lesson in order to meet the special needs of each individual student, develop cooperative projects or work on specific tasks.

Cooperative Learning

Cooperative Learning ingrains the "Stronger together" concept in students; building team-spirit in them that working in group improves involvement and acquisition of knowledge and successful accomplishment of tasks. Groups of 3 to 6 members is formed and coordinated by the teacher with each member handling specific task(s) in order to achieve the set objective(s).

Gamification

Gamification is gaining more ground in curriculum and classroom environment. It is one of the bases of edutainment in EdTech industries.

Design Thinking

Design Thinking (DT) helps curricula developers, teachers, researchers and industries to collaborate, tinker, research, innovate, create, problem-solve and bring about reform in teaching methodologies in the classroom and development in the society.

Thinking-Based Learning

Thinking-Based Learning (TBL) methodology develops effective thinking skills in students beyond mere rote memorisation and regurgitation of content. It teaches students to contextualise, analyse, relate, argue, convert information into knowledge, knowledge into working skills and skills into innovative implementation.

Problem-Based Learning

Problem-Based Learning (PBL) is an iterative learning process which begins by asking questions and exploring ways to solve the identified problem. It is an inquiry-based learning with which students develop critical thinking, creative skills and problem-solving knack through quests and knowledge sharing.

Project-Based Learning

Project-Based Learning (PBL) is a classroom innovation that uses experiential learning models and design thinking to get students involved in learning activities that are focused on outcomes. Through projects that address real-world issues without compromising curriculum content, it helps students gain knowledge, skills, and competences. In contrast to the conventional theoretical and abstract paradigm, PBL flips the teaching process by beginning with a tangible problem. It helps students retain information while fostering 21st century skills including communication, critical thinking, and teamwork in problem solving. While the teacher offers guidance and support throughout the project, PBL encourages students to plan, organise, carry out, and present the project's outcome.*"PBL today represents the best didactic guarantee for*

an effective contribution to the development of students' key competencies" Realinfluencer, (2019)

Competency-Based Learning

Competency-Based Learning (CBL) is a collection of tactics used to accomplish the three main objectives of all learning approaches: knowledge acquisition, skill development, and the creation of operational standards. With CBL, tool kits such as teaching devices, assessment rubrics, curriculum roadmap, and training guide are collaboratively developed by teachers and students and operationalised in real- life practices, giving students a concrete dimension to their learning.

All these strategies are learner-centred. The efficiency and effectiveness of instructional process takes place while the teacher interacts with the learners through explanation, exploration, experimentation and discussion while students gain competency in the three Cs of the 21st century (communication, critical thinking and collaboration). Learning as an activity takes place while the student's mind is actively engaged through a series of well–structured experiences. Teachers prepare the lesson in an activity-based approach and guide the students to self-discover concepts contextually. Teachers need to consider certain crucial factors while adopting learner-context approach as successfully implemented in a study by Adedokun-Shittu, Abdulkabir, Nuhu (2018). These include teachers: recognising the fact that students are not empty vessels and they emanate from an environment where their lived experiences can complement their learning, if creatively and constructively connected to concepts; collaborating with colleagues and students both physically and virtually. They are expected to come up with relevant ideas to teach different topical issues in varying subjects; exploring language, culture, childhood games, proverbs, as rich resources to learn from and relate subject concepts to and to facilitate contextual understanding. This requires teachers to be grounded in both subject content and local context, engaging students to take active role in their learning rather than passive listener in class. These interactive and student-engaging activities should be provided for in the lesson plan, making ample provisions for relevant problem-based and inquiry-based activities for each topic. These can be achieved more effectively if students' observation from the activities are carried out form their notes or diary.

Flipping the classroom with web resources such as videos, audio, texts, real setting excursion could also be employed to complement contextual teaching.

Having studied and used many methodologies available globally for 21st century learning, GLOCALISE carefully adapted the following methods to our local context. These methods are discussed as applied by GLOCALISE across all levels of Education in Nigeria.

Glocalisation of Education at the Basic, Secondary and Tertiary Levels of Education

Basic education, secondary school education, and university education are the three main levels of education in Nigerian society, Africa, and the rest of the world. Children between the ages of four and fourteen are typically offered basic education, which includes three years of early childhood and development education, six years of primary and junior secondary schooling, three more years of senior secondary schooling, and four or more years of tertiary education (Nwangwu, 2012). The Nigerian educational system is divided into three promotional levels, according to the National Policy of Education: postsecondary education, post-basic and career development (PBECD), and basic education. Pre-primary education, primary education, junior secondary education, and early child care development education (ECCDE) make up basic education.

Technical and vocational education and training (TVET) and senior secondary education make up the PBECD. University education, teacher education, technological education, and innovation enterprise institutions are all considered tertiary education (Federal Republic of Nigeria, FRN, 2014). It is crucial to stress that students are expected to accomplish a variety of goals and objectives at each level, including the development of suitable mental, physical, and social skills and competencies that will enable them to make valuable contributions to society.

What Should Students' Learning Experience Be Like? Discovery in Learning

What excitement is felt by a child and parents as the baby takes his/her first step? The baby is our student, while the parents are the teachers. That's the excitement every student and teacher should experience in every class.

MESSAGE: Discover something new in every topic you explore with your students. Let our students EUREKA!!!. Teachers also become part of the learning experience; they become partners in discovery. He/she searches for appropriate resources for contents to explore, design relevant problem-based classroom activities for students, prepare the activity guide for every flipped learning, design rules and procedure for game-based learning and provide guide for students' diary. All these are entrenched in the roles designated for teachers as: Facilitator, Designer, Collaborator, and Learner (ISTE – International Standards of Teacher Education, 2022). Rather than copying teacher's note, students should develop their diaries from observations made during the exploration or activities. Teachers in turn analyse the content of the resources provided, critique students' diary, compare their observations, note some inconsistencies in their submission and reconcile them.

At the Primary level

Storytelling, replicating moonlight tales is an effective learning strategy for primary school age pupils. Story-telling is a fascinating method of capturing and sustaining students' attention. When relevant stories are told in class it brings out meaningful moral lessons that will allow students to link subject content to local context. Story-telling could also lighten the tension in subjects presumed to be difficult and boring. Interactivity is also ensured with story-telling when students are requested to contribute the moral lessons of the story or relate it to the topic of discourse. The story of how Noah's Ark was constructed could come in as teachers teach floating, students marvel at how a gigantic ark could stay afloat on water and practice how to make a boat, paper boat etc. More fun is added to the class if the story has songs with stanzas to chorus. It becomes much more fascinating if the story is accompanied by a song to be chorused by the pupils e.g. *Asirin toun tokere, joo mi jo, awon ni won jo nja, joo mi jo….*

Game is an activity-based method of capturing students' cognitive involvement in the topic or subject to be taught. Both physical and computer-based games serve the purpose of fun and educative engagement of the students in the topic. Many of the childhood games we played can seamlessly come to play while teaching. Besides improving the cognitive and social skills of students, games can impress a meaningful and permanent experience about the lessons on the students. GLOCALISE games include: "*Eni bi eni, eji bi*

eji, eta nta gba, erin woroko,.. to teach elementary counting" *lanka-lanka* (hop-scotch), *ayo olopon*, binary, for addition/subtraction, *tente, tinko, okoto tita*, to express BODMAS.

At the Secondary Level

Teach Thinking: use computational thinking strategies – procedural or algorithmic skill.

Thinking Activity:

Now, take your pencil and paper:

Calculate this:

Add up all the numbers from 1 to 200 in just 1 minute.

MESSAGE: Provide activities that make your students think and solve problem not just rote memorisation.

YOU might just be NURTURING OUR own EINSTEIN

What triggers thinking? QUESTIONING!

- In the thinking activity above,

  Did I provide CONTENT or CLUE?

  Did you get my message or not?

Did it make you ACTIVELY THINK or PASSIVELY receive my message?

Questioning is a skill used by teachers to engage and interact with students on a subject matter. It can prompt students' reasoning and guide them to observing certain phenomenon, demonstration activity or experiment. It prevents teachers from spoon-feeding their students on every topic but prompts students to be active participants in their learning. Puzzles and riddles are brilliant contextual way of engaging students in critical thinking; they can be used to question students to guide their thinking on a particular subject/topic. Riddles like: *Opa tinrin kan ile okan orun kini o*? Ojo – meaning: 'a thin staff reaches the sky and the earth, what is it? - Rain' to teach ecosystem. Trigger students while teaching ecosystem to explain why Yorubas will say "*a kii bu sango ni eerun*", no one abuses the sango deity in the dry season? Because no rain, nor thunder in the dry season, so it has no implication because thunder will not strike in rainless season. Use proverbs

that go along with concepts in Physics, Chemistry, Biology. '*Laalaa to roke, ile lo nbo*' - a Yoruba proverb explaining perfectly the 'Law of Gravity'. *Yoo bale, yoo bale ni labalaba fii wo igbo* – an incantation line describing the concept of gravity. *Iromi to n jo lori omi, onilu re wa nisale odo* - relating the upthrust that exists when a body is immersed in a fluid that's Archemedes principle in Physics. *Ayo okoto* – game of Oscillation. – What is the rationale?

Whenever you state a LAW in class? Do you allow your students to question WHY?

Our answer can't be – that is how the law is stated? QUERY why and discover the rationale.

MESSAGE: Let's create our own NEWTONs.

Look inward into students' lived experiences, relate them to concepts you teach, challenge them to think in that direction, generate inspiring activities to achieve curriculum content.

Sublimation – don't define

– Carry out experiment (shear butter, camphor, air freshener)

Let them record their observations and put up their own definition (students' diary)

Student-diary - rather than teacher's note develops students' constructive ability, it encourages them to develop their literary skill and better understanding of concepts taught. In activity-based or inquiry-based learning, students' observation should be noted themselves. Further explanation given by teachers would also be developed in their own language then, assessed by the teacher to clarify their misconceptions and wrong interpretation. In this method, students can retain the understanding of the concepts they formulated themselves compared to reading and memorising teachers' note. This method may be faulted for indolence on the part of the teacher. However, it requires more active teacher involvement in the students' work.

Don't Write Notes That Can Be Found in Textbooks or Even on the Internet

Flipping is a method that requires students to consult additional resources like Internet resources (video, audio or textual), or even educational television and radio programmes, on topics to be discussed later in class. They would be

given study guide and questions on what to focus on in the resources given. They could also be required to conduct some activities based on the content learnt in the resources and they will eventually develop their own notes from the resources reviewed. Thereafter in class, the teacher will spend the class time interacting with the students on the flipped material – discussing the study guide and questions, answering conflicting queries from students, analysing the activities given and assessing students' notes. This method ensures maximum and judicious utilisation of class time without any fear of not completing the subject syllabus.

At the Tertiary Level

Experiential Learning - Impactful Learning

- Picture this scenario –
    - 1. You heard about a ghastly motor accident
    - 2. You witnessed a ghastly motor accident
    - 3. You were involved in a ghastly motor accident, but THANK GOD!!! You SURVIVED.

What's the experience in each situation?

How long will the effect in each case last?

Which has the mostlLasting IMPACT?

MESSAGE: Create a more lasting IMPACT in every lesson

Chinese Maxim: What you hear, you forget; what you see you remember; but what you do, becomes part of you make your students active not passive

Outcome-Based Learning

Apprenticeship Approach

- Which do you prefer? 1 or 2?

1- A child learns auto-mechanics in 5 years, become a road-side mechanic-can fix any car. The best in town.

2- A child goes to university for 5 years, learn all theories of auto-mechanics-can't fix a loose bolt in his car.

Now, which is better 1 or 2?

- What's the point?

I learn all the laws of electricity but I can't apply it?

That's the question every student should ask you (Teacher/Lecturer)

Message- Help your students learn, apply and change the world for better.

Your student might be the next world celebrated inventor

Message: make your lessons concrete

We'll marvel at our discoveries

Theorists and law proponents in this field observed real life situations as they encountered them in practice and documented them for future references. What references will our future engineers leave behind if all they do is to study for grades? Quite pathetic that we roll out graduates with first class and second class upper year in year out without substances to show with the exception of a few though. As teachers, how do we turn around this situation? While we teach, let's create problems for students to solve. Just like a naughty young boy will break his father's radio and assemble it back, whether it works or not, he made an effort. After all, Thomas Edison tried to invent the light bulb 9999 times before he succeeded the 10,000th time. So, teachers should provide an avenue for their students to try and make mistakes; let them document all the trials and errors they make, what differ in each stage, in each trail. Perhaps, eventually, they will make an edge way. Not at every error would the teacher intervene, but we should provide further guide, tip or ask prompt questions that will channel a possible direction. As they venture into this discovery learning, they will consult previous textbooks, theories, laws; and the theoretical knowledge we teach in class will eventually be learnt along in their adventure. As they do this, it becomes part of their experience - not the 'la cram la pour' syndrome.

Seem quite Unrealistic? Pedagogical Implications of GLOCALISE Approach

- No time to complete the syllabus?
- No resources to achieve these?
- Too many students in class?

To achieve this seemingly unrealistic approach, Adedokun-Shittu, Abdulkabir, Nuhu, (2018) guided teachers on how to discountenance passive Learning Objectives (LO), create and focus on active SMART (Simple, Measurable, Attainable, Realistic and Timely) objectives, by subsuming the passive LOs under the active LOs and thereby achieving more than the curriculum stipulates. Avoid LOs like define concepts, list or state…, substitute with - demonstrate how the concept works in real life, explain the algorithmic process of achieving such concepts and describe a simple activity that explains the concept, design a game to enliven the concept, relate the concept to real life, day to day activities. When these higher order LOs are achieved, lower ones are automatically catered for.

Assessment also changes with the GLOCALISE Approach. The UNESCO International Bureau of Education IBE (2013) glossary of learners' assessment is adopted. "Assessment as learning" encourages learners to self or peer-reflect on their learning. "Assessment for learning" adapts the educational processes to meet learners' needs, identify learners' strengths and weaknesses and provide support to reinforce them. "Assessment of learning" in the form of standardised tests or centrally-set examinations to assess learners' achievement for certification is used to fulfil standardised education requirements and for GLOCALISE learners to compete favourably with their peers locally and globally. "Assessment of learning outcomes" uses varying methods - tests, oral or written, projects and portfolios to assess students' attainment of learning outcomes. GLOCALISE uses a reverse assessment by laying more emphasis on "Assessment of learning outcomes" as an integrative assessment approach by engaging students in problem/project-based activities, which systematically subsume other forms of assessment. A problem/project-based activity on a topic in class will have taken learners through assessment as learning through questions and activities that prompt self and peer reflection. Assessment for learning through provision of relevant GLOCAL support resources like proverb, artifacts, real life scenario, flipped resources from web links will reinforce learners' weaknesses and fortify their strengths on the concept. Students' observations noted in their diary will be verified with validated sources such as textbooks and web resources. All these would have prepared learners with the cognitive, affective and psychomotor abilities to intelligently solve any problem encountered in standardised tests no matter how craftly structured they are.

With the GLOCALISE approach, curriculum remains unsafe from changes. There is need for radical restructuring of the curriculum and deepening involvement from government, parents, school administrators and all stakeholders in education. Students and parents' active engagement is paramount; teachers become comfortable with a changing role as a coach and facilitator, no longer a sage on the stage and school administrators become understanding partners in this approach. Consequently, the nature of lesson plan, class structure and teacher-orientation changes, syllabus and curriculum restructuring become inevitable, textbook redefinition is crucial and definitely, assessment will not be limited to summative test and measurement, it becomes an all-inclusive learning and outcome-based assessment.

Higher Institutions and Community Service Role

The connection between town and gown in higher education provides community and collaborative services to transform our education sector to the tinkering sector for human and capital development. The iterative model in figure 1 explains the GLOCALISE Outcome-based Learning Strategy, which shows how the the Faculties of Education in our tertiary institutions should play a crucial role in training teachers across all levels of education to explore African culture for educational transformation. The Faculties are expected to give students perceptive hints and questions to encourage critical thinking, develop creative activities through problem/project based solutions, transform projects into prospects, thereby making African education meaningfully outcome-based.

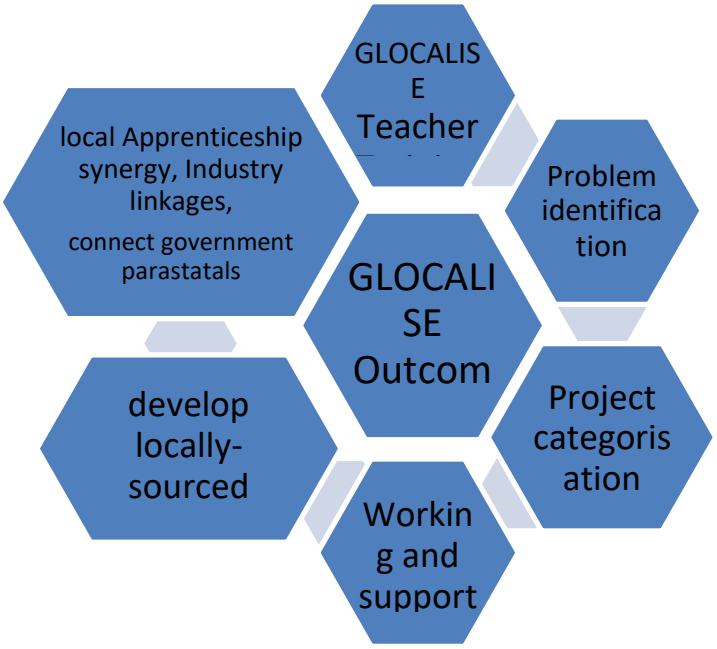


Figure 1: GLOCALISE Outcome-based Learning Strategy (GLOCALISE, 2023)

The GLOCALISE Strategy for achieving outcome-based learning thus should identify problems across society, form interdisciplinary working group, distribute tasks, create professional support groups, identify locally-sourced materials to develop prototype solutions, foster synergy with local skilled workers and upscale apprenticeship, link up with industries to provide support, then connect relevant government parastatals to adopt the outcome as a national achievement, and finally promote internationally, especially through social networks and global exchange programmes. This will monumentally impact on Quality Education as entrenched in the Sustainable Development Goal (SDG 4) of every community adopting GLOCALISE Outcome-based Learning Strategy.

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CHAPTER THIRTEEN

Empowering Visually Impaired Students: Developing Educational Assistive Technologies for Inclusion in the Nigerian University System

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Abstract

Students with visual impairments in Nigerian universities continue to encounter significant barriers to learning, including inaccessible educational materials, inadequate assistive technologies, insufficient institutional support, and limited educator preparedness for inclusive teaching. This paper presented a conceptual framework for promoting educational inclusion through the development of localised assistive technologies, accessible learning resources, educator capacity-building, and institutional policy reform. Drawing on Inclusive Education Theory, the Social Model of Disability, Universal Design for Learning (UDL), and the Capability Approach, the paper proposed an integrated model to enhance access to higher education for students with visual impairments. Central to the framework is EVISVision, an assistive mobile learning application designed to support independent access to educational content through text-to-speech, optical character recognition, voice navigation, and offline functionality. The framework also emphasised the conversion of academic materials into Braille, audio, large-print, and screen-reader-compatible formats, as well as systematic staff training and policy implementation. The paper contributed to the ongoing discourse on inclusive higher education and offered practical recommendations for advancing Sustainable Development Goals 4 and 10 through equitable access to quality university education in Nigeria.

Keywords: Inclusive Education, Assistive Technologies, Accessibility, Policy Reform.

Introduction

Inclusive education is an educational approach that identifies and removes barriers to learning, ensuring all students, regardless of ability or background, can learn together effectively (UNESCO, 2025). In Nigeria, as in many countries, inclusive education has gained prominence as a strategy to provide quality education for all and to address disparities in access. Visually impaired students represent a significant group that faces unique challenges in higher education. Visual impairment ranges from low vision to total blindness, affecting a person's ability to read standard print or navigate visual materials (Garcia, 2024). Globally, the scale of visual impairment is substantial, at least 90 million children worldwide live with some form of vision loss or blindness and Nigeria is no exception (89up, n.d.). An estimated 4.25 million Nigerians over age 40 have moderate to severe visual impairment or blindness, indicating the magnitude of need for accessible learning solutions (Dineen et al., 2006). Visual impairments can drastically impede students' educational experience by limiting their access to textbooks, lecture presentations, and other visual learning resources.

The push for inclusion is grounded in fundamental rights and international development agendas. Sustainable Development Goal (SDG) 4 calls for inclusive and equitable quality education and lifelong learning opportunities for all, explicitly including persons with disabilities in its targets (United Nations, n.d.). Similarly, SDG 10 aims to reduce inequalities by empowering and promoting the social inclusion of all, irrespective of disability status (Casey, 2020). Nigeria has affirmed these goals by adopting policies aligned with the UN Convention on the Rights of Persons with Disabilities (CRPD). For example, a 2017 national policy defines inclusive education as "the process of addressing all barriers and providing access to quality education to meet the diverse needs of all learners in the same environment" (UNESCO, 2020). In practice, however, many Nigerian students with disabilities remain excluded or struggle within universities, due to insufficient accommodations and support (UNESCO, 2020). This gap between policy and reality highlights the need for concrete interventions.

Assistive technologies and educator training are key strategies to bridge this gap. Modern digital tools have transformed how students learn, and assistive technology (AT) can be life-changing for those with visual impairments.

Research confirms that AT can significantly increase the inclusion and accessibility of students with disabilities in education (Fernández-Batanero et al., 2022). Screen readers, text-to-speech software, electronic Braille displays, and other innovations allow visually impaired learners to access information and participate more equally. Yet, studies also show that significant barriers persist - notably a lack of teacher training in using inclusive strategies and technologies, limited information about available AT, and infrastructural or accessibility challenges (Fernández-Batanero et al., 2022). In Nigeria's universities, many lecturers have never received formal training on inclusive education techniques, and assistive devices or materials are often scarce. Even well-intentioned inclusion policies cannot succeed without knowledgeable educators or available tools.

This paper addressed these challenges by focusing on four interconnected priorities: developing assistive learning technologies tailored to visually impaired students, training educators in inclusive pedagogy, adapting academic materials into accessible formats, and advocating for supportive institutional policies. The project aimed at creating an enabling environment that empowers visually impaired students by addressing technological and human factors. These efforts directly support SDG 4's mandate of inclusive education and SDG 10's call to reduce inequalities, helping ensure that a visual impairment is not a barrier to university success. The main goal of this paper is to provide a comprehensive plan for fostering an inclusive Nigerian university system where visually impaired students can thrive alongside their sighted peers.

Conceptual Framework

Inclusive Education Theory

Inclusive education theory posits that schools and universities should accommodate all learners by eliminating barriers and providing support in regular education settings. Rather than segregating students with disabilities, the inclusive model strives to modify the environment and teaching practices to suit diverse needs. According to UNESCO, inclusive education involves "reinforcing the capacity of education systems to welcome and reach out to all learners" (UNESCO IIEP, n.d.). It covers everything from adapting curricula and pedagogy to training teachers and redesigning physical spaces (UNESCO, 2025). In the Nigerian context, inclusive education is a key strategy for

achieving SDG 4 and ensuring equitable education. National policy now frames inclusion as addressing all barriers (physical, informational, attitudinal) that impede any learner (UNESCO, 2020). This theory guides the project's holistic approach – rather than expecting visually impaired students to "fit" into an unaccommodating system, the system must change. All components of the university environment (course materials, teaching methods, infrastructure, policy) should be made accessible. The emphasis is on equal participation: visually impaired students learning alongside sighted peers, with appropriate supports in place. By grounding the project in inclusive education principles, we aim to foster an academic culture that respects diversity and provides "the same opportunities to participate in society as their peers" for students with disabilities (Fernández-Batanero et al., 2022).

Social Model of Disability

This project is also informed by the social model of disability, which distinguishes between an individual's impairment and the disabling barriers imposed by society. Under the social model, people are *not* disabled by their medical condition per se, but by external obstacles – e.g. inaccessible buildings, lack of assistive tools, or prejudiced attitudes (Disability Equality in Education, n.d.). In other words, disability is a product of the interaction between individuals and their environment. A visually impaired student has a functional vision limitation, but whether that becomes a "disability" in education depends on social arrangements. A rigid curriculum that assumes all students can read standard print, or a library without screen-reading software, creates disability by preventing that student from fully participating (Disability Equality in Education, n.d.). The social model calls for removing these barriers to create equality and offer disabled people more independence, choice and control (Disability Equality in Education, n.d.). Applying this lens, the project focuses on fixing the environment – providing assistive technology, accessible materials, and inclusive teaching – rather than "fixing" the student. For example, if a textbook is only available in regular print, a blind student is disabled by that format; but converting the book to Braille or audio removes the barrier, and the student can learn on equal footing. The social model of disability thus underpins our advocacy for institutional policy: universities must change policies and allocate resources to accommodate diverse needs. It also fights the stigma that "disabled people cannot do certain

things" by demonstrating that with the proper support, visually impaired students can excel (Disability Equality in Education, n.d.). Embracing this model, the project treats accessibility and inclusion as collective responsibilities of the university system.

Universal Design for Learning (UDL)

Universal Design for Learning (UDL) is a framework that translates inclusive education into practical instructional design. Originating from architecture's universal design concept, UDL asserts that educational materials and methods should be designed from the outset to accommodate a wide range of learners, rather than retrofitting accommodations later. Sharma et al. (2023, p.34) defined UDL as "an educational framework that aims to create inclusive learning environments by providing multiple means of representation, action and expression, and engagement for all students, regardless of their learning styles, abilities, or disabilities." UDL encourages teachers to present information in various ways (visual, auditory, tactile), allows students multiple ways to demonstrate knowledge, and uses diverse strategies to engage and motivate. By proactively removing learning barriers and offering flexibility, UDL reduces the need for individual special accommodations (Sharma et al., 2023). This project incorporates UDL principles in training educators and adapting curricula. For instance, converting materials into Braille, audio, and high-contrast large print ensures multiple content representations, benefiting visually impaired students and others. Likewise, the EVISVision app with its voice navigation and text-to-speech features provides alternate means of accessing content and completing tasks. UDL also stresses an inclusive digital learning environment: our plan to create accessible e-books and screen-reader-friendly documents aligns with making the digital course space navigable to all. By guiding lecturers in UDL-based lesson planning (e.g. always describing visual aids orally, providing lecture notes ahead of time in accessible formats), we institutionalise inclusive practices. Consequently, UDL serves as a design checklist to ensure all project outputs – whether a piece of software, a teaching guide, or an assessment method – are as usable by the broadest range of students. This contributes to sustainable inclusion beyond the project's direct beneficiaries.

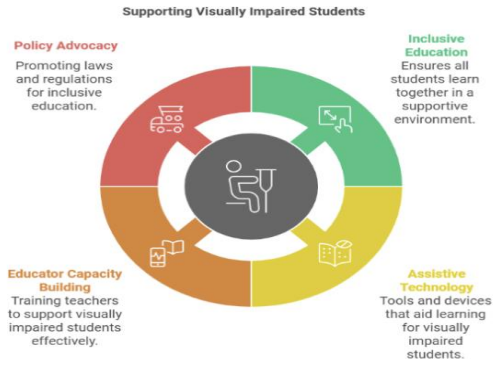
Capability Approach

Another conceptual pillar for this project is Amartya Sen's Capability Approach, particularly regarding disability and education rights. The capability approach focuses on expanding what people can be and do – their substantive freedoms or "capabilities" – rather than just providing resources. In the context of persons with disabilities, this approach argues that true equality entails enabling individuals to achieve functionings they value (such as obtaining a university education or pursuing a career), not merely treating everyone equally. As Broderick (2018) noted, the capability approach "focuses on ensuring equality and developing human potential," offering a way to move beyond traditional measures of educational equality that only count inputs or test scores (Broderick, 2018). Applying this to inclusive education, we ask: do visually impaired students have the capability to succeed in higher education equally? If a blind student has a right to education but cannot access textbooks or campuses lacking Braille materials, their freedom to learn is curtailed. The capability approach thus supports providing assistive technology, alternative formats, and supportive teaching as essential to expanding a student's freedoms. It aligns closely with Article 24 of the CRPD, which guarantees persons with disabilities the right to education and requires states to facilitate their "full development of human potential and sense of dignity and self-worth" (Broderick, 2018). By giving visually impaired students the tools (capabilities) to learn independently – e.g. an app to read any text aloud, or training that enables teachers to include them in class discussions – we enhance their agency and educational outcomes. This approach also informs our evaluation: success is measured by the extent to which students can perform academic tasks and participate in university life, rather than just the provision of equipment. The capability lens reinforces that quality education for disabled students is a matter of justice and empowerment, not charity. Therefore, each component of our project (technology, training, materials, policy) is aimed at removing conversion handicaps and unleashing the capabilities of visually impaired learners to achieve their academic and life goals.

Interconnection of Technology, Training, and Policy

Crucially, these frameworks are interconnected in practice – technology alone cannot foster inclusion without trained educators and supportive policies, and

vice versa. The conceptual model driving this project sees assistive technology development, educator capacity-building, and policy advocacy as synergistic strategies that must work together. For example, the social model and UDL indicate that simple introduction of an assistive device (screen-reading software) is insufficient if instructors do not know how to integrate it into teaching or if university rules do not mandate its availability. Likewise, teacher training on inclusive methods will have limited impact if appropriate tools or materials are not available to implement those methods. Thus, the project adopts a systems approach: technological solutions (EVISVision app, accessible format materials) are deployed alongside human solutions (training, disability support services) within an enabling institutional framework (policies and funding).



(Figure 1: Conceptual model linking assistive technology, educator training, and inclusive policy for empowering visually impaired students)

Figure 1 (conceptual diagram) illustrates this interplay: the visually impaired student is at the centre, surrounded by three support pillars – technology, pedagogy, and policy. *Technology* (such as the EVISVision app and Braille/audio textbooks) provides access; *teacher training* ensures the pedagogy adapts to include the student using those means; and *policy* provides the mandate and resources to sustain both the technology and inclusive practices across the institution. If any pillar is weak, inclusion may fail. Findings in the literature support this integrated approach. Fernández-Batanero et al. (2022) emphasise that while assistive technologies improve inclusion, barriers like insufficient teacher training and lack of information can undermine their effectiveness (Fernández-Batanero et al., 2022).

Correspondingly, a policy brief on inclusive education management in Nigeria found that improving inclusion requires adequate teacher training, provision of teaching resources, and strong policy support, including proper funding (Nwakudu & Oliobi, 2021). Our conceptual framework, therefore, treats the development of AT, educator training, and advocacy for institutional policy as three strands of a single braided rope – all necessary to pull the system towards true inclusion. This theory of change guides the research methodology and implementation plan described next.

Methodology

The project employed a mixed-methods research design combining qualitative and quantitative approaches to achieve the stated objectives. This comprehensive methodology was structured in several phases: Needs Assessment (Qualitative and quantitative), Development of Localised Assistive Technologies (Design Research), Pilot Testing and Evaluation (Mixed Methods), Policy Advocacy, and Stakeholder Engagement.

Throughout all phases, ethical consideration was paramount. Informed consent was obtained from all student and staff participants, with assurance of confidentiality and the right to withdraw from the study at any time. Research involving vulnerable populations (students with disabilities) were approved by institutional ethics committees and conducted in accordance with international ethical standards. Feedback loops was incorporated; and preliminary findings were shared with participants and stakeholders for validation (member checking), ensuring the research accurately represented their perspectives and needs.

Expected Outcomes

Deployment of the EVISVision Assistive Mobile Learning App

A fully functional mobile application (with companion desktop and web versions) will be launched and made available to students. The app, described below, will enable visually impaired learners to access digital content through text-to-speech and other features. We expect at least 100 visually impaired students to be actively using EVISVision by the end of the project's pilot phase, with expansion in subsequent semesters. The app will be open-sourced and freely available, allowing further adoption by other universities and integration of additional features over time.

Conversion of Academic Materials into Accessible Formats

At least 20 core textbooks and numerous course handouts across different disciplines will be adapted into Braille (both embossed and refreshable digital Braille), audio (narrated or text-to-speech MP3), large-print, and screen-reader-friendly electronic formats (such as accessible PDF, EPUB3 or DAISY books). This includes foundational texts in subjects like law, psychology, literature, and science, which were identified as high-priority by the student needs assessment. The converted materials will be catalogued in an Accessible Educational Materials (AEM) repository within each pilot institution's library, creating a lasting resource. For example, if a Political Science textbook in print is converted to Braille and audio, future blind students can readily obtain those formats without delay. By the end of the project, visually impaired students in the pilot universities should be able to access all their semester readings in at least one accessible format.

Enhanced Capacity of Educators and Staff (200+ trained)

Over 200 lecturers, instructors, and academic support staff will receive training in inclusive education practices and the use of assistive technologies. This includes those who attended our intensive workshops, plus additional faculty reached through departmental training sessions and online modules developed by the project. We anticipate a measurable improvement in educators' attitudes and self-efficacy regarding teaching students with disabilities. For instance, post-training surveys are expected to show significant gains in participants' confidence to adapt materials or utilise tools like screen readers. Each trained educator becomes an ambassador for inclusion within their faculty. In the long run, this growing cohort of sensitised and skilled staff will foster a more inclusive campus culture and ensure that gains are not lost when the project concludes.

Institutional Adoption of Inclusive Education Policies

A critical outcome is achieving institutional and policy changes that embed support for visually impaired students into the system's fabric. We aim to have at least a few partner universities formally adopt new policies or guidelines due to our advocacy. Examples include: establishing a Disability Services Unit on campus (with at least one staff coordinator appointed to assist students with special needs), including provisions for accessible infrastructure and materials in the university's strategic plan, or signing an

MOU with the project team/NGOs to continue providing assistive technology support after the grant period. At the national level, we seek acknowledgement of our model in policy discourse – for instance, influencing the Federal Ministry of Education to incorporate our training curriculum into national teacher training programmes, or securing budgetary commitments for assistive devices in tertiary institutions. Success would be indicated by concrete actions such as a government directive urging all universities to implement the 2017 Inclusive Education Policy and report on progress, or by additional funding streams (from government or donors) dedicated to scaling the project outcomes. Overall, the objective is to move from isolated interventions to institutionalised inclusion.

EVISVision: Assistive Mobile Learning App

One of the project's flagship innovations is the development of **EVISVision**, an assistive mobile learning application designed to support visually impaired students in Nigeria's university system. The name "EVISVision" stems from Empowering Visually Impaired Students through Vision technology, reflecting its core purpose of opening educational content to those without sight.

Purpose and Concept

EVISVision is a personal learning companion for visually impaired students, turning a standard smartphone into a multi-functional assistive device. The app addresses everyday challenging academic tasks for blind or low-vision learners, such as reading textbooks, scanning printed handouts, navigating campus information systems, and controlling digital interfaces, by providing seamless audio and tactile (via vibration or optional braille display) interactions. The overarching goal is to enable students to study and navigate educational materials independently, without always needing a human reader or aide. By leveraging the ubiquity of mobile phones, EVISVision offers a low-cost, portable solution that can be widely adopted. Importantly, it is localised to the Nigerian context: it supports Nigerian English accents and Pidgin (for text-to-speech and voice commands). It is tuned for the content Nigerian students encounter (for example, it can correctly pronounce local names or places in texts).

Key Features

Screen Reading & Text-to-Speech (TTS): The app can read aloud digital text content, such as e-books, PDFs, Word documents, or web pages. Students can load their lecture notes or digital textbooks into EVISVision, and the built-in TTS engine will convert the text to clear spoken audio in a natural-sounding voice. The reading speed, voice pitch, and language accent are adjustable. This feature transforms any electronic document into an audiobook on demand, enabling visually impaired students to listen to their study materials. For instance, a student can listen to a PDF article on their phone while commuting or revise lecture slides by having them narrated by the app. (This is akin to mainstream screen reader software on computers, but optimised for mobile and academic use.) The importance of such technology is well-documented – tools like screen readers have revolutionised access to information for blind individuals (Australian Disability & Community Education & Training Ltd, n.d.). EVISVision extends this to the mobile learning context.

Optical Character Recognition (OCR): A standout feature of EVISVision is its OCR capability, which allows users to convert printed text into speech. Using the phone's camera, a student can snap a photo of a printed page – e.g. a textbook, class handout, or library article – and the app will analyse the image to recognise the text and then read it aloud. This empowers students to access print materials not previously available in Braille or digital form. For example, if a professor distributes a paper handout in class, a visually impaired student can use EVISVision to scan and listen to it immediately, rather than waiting for a transcribed version. The app provides audio guidance for capturing images (e.g. it can speak prompts like "move camera to the left" to help the user position the page correctly, similar to features of the KNFB Reader) (Australian Disability & Community Education & Training Ltd, n.d.). The OCR feature, which works offline once the language pack is downloaded, is crucial in a developing context where internet access may be unreliable. By bridging the gap between physical print and digital audio, EVISVision significantly reduces dependence on sighted assistance for reading.

Voice-Controlled Navigation: EVISVision is built to be used *eyes-free*. Users can navigate the app's functions and device using voice commands or simple gestures, minimising the need to look at or precisely tap the screen

(which is difficult for blind users). The app recognises spoken commands for everyday actions – for instance, a student can say "open Biology textbook Chapter 3" or "search for Introduction to Economics in the library" and EVISVision will execute the command. It also has an interactive voice assistant mode to answer queries like "what are my reminders?" or "go to page 50." Additionally, through integration with the phone's accessibility services, EVISVision allows voice or gesture control of other apps (for example, controlling a slideshow or recording). This not only aids in app usage, but also helps with general smartphone accessibility for academic tasks. For instance, a student can dictate an SMS or email to a lecturer, or ask EVISVision to announce incoming notifications, ensuring they stay connected with class communications. The voice interface is crafted to understand Nigerian English accent and common phrasing, making it user-friendly for local students.

Multi-Platform Support (Android, iOS, Web): Recognising that students may have different devices, EVISVision is being developed for Android (the most common smartphone OS in Nigeria) and iOS, with a web-based version for use on laptops or library computers. The core functionality remains consistent across platforms. A student could use the phone app on the go and log into EVISVision on a computer in a campus ICT centre to access the same features (screen reading, etc.) on a larger screen or with a hardware braille display. Synchronisation features allow notes or bookmarks to be shared across devices. This cross-platform approach ensures no student is left out due to device type and allows integration into university computer labs.

Offline Functionality: Given unreliable internet connectivity in many regions and the cost of mobile data, EVISVision is designed to work predominantly offline. After initial installation and downloading of necessary language packs and libraries, features like OCR and TTS operate without needing the internet. Students can use the app in remote campus areas or at home without connectivity. Cloud-based features (such as backing up user notes or downloading additional voices) are optional. This offline-first design is a practical necessity in the Nigerian context and ensures the tool is accessible to students regardless of their connectivity situation.

Localisation and Academic Integration: The app includes features specifically for academic use: an academic calendar and reminder system

(students can receive spoken reminders of class times, assignment due dates, or exam schedules), a feature to navigate by headings or page numbers within textbooks easily, and compatibility with library systems (potentially allowing students to search their university's library catalogue via the app). By collaborating with university libraries, we aim for EVISVision to serve as a portal to accessible library resources eventually. Sustainability is also built by making the app open-source – the code and documentation are publicly available so that university IT departments or local tech communities can contribute to its maintenance and improvement. The project is working with campus tech clubs and international NGOs to build a community of developers who will keep EVISVision updated and free. The open-source nature also fosters ownership: Nigerian universities can customise the app (e.g. add specific course materials or modules) to best serve their students.

Sustainability and Support: For EVISVision to have a lasting impact, plans are in place for ongoing support. The app will be institutionalised through university adoption – we are advocating that partner universities formally endorse the app as a recommended learning aid for students with visual impairments. Ideally, each university would have an ICT officer or disability support staff trained in the app's use, who can assist new students in onboarding and handle any technical issues. We have also partnered with a Nigerian tech NGO focusing on accessibility; they have agreed to host the open-source project repository and coordinate volunteer contributions post-project. Moreover, we are exploring collaborations with corporate sponsors (such as telecom companies or tech firms) to fund future development or possibly bundle the app on devices provided to students. The goal is for EVISVision to continue evolving beyond the initial project, adding features like STEM equation reading, integrating with braille notetakers, or incorporating AI for smarter image descriptions, thereby continually empowering new cohorts of visually impaired students.

Textbook & Academic Material Conversion Process

In tandem with developing new technology, the project strongly emphasises converting and producing accessible academic materials. Accessible Educational Materials (AEM) are instructional resources reformatted or designed to be usable by the broadest range of student abilities (CAST, n.d.). For visually impaired students, the main formats of interest are Braille, audio,

large print, and navigable e-text. Our conversion process is designed to yield materials in all these formats, ensuring redundancy and preference matching (since students have varying needs and preferences – some may be fluent Braille readers, others prefer audio, etc.). The process involves collaboration among subject matter experts, assistive technology specialists, and professional transcribers. Key formats and steps include:

Braille (Digital and Embossed)

Braille remains a crucial medium for many blind scholars, especially for detailed reading and technical subjects (where spelling, punctuation, or notation is important). Our team uses Braille translation software to convert text into Grade 2 Braille code, followed by proofreading by certified Braille transcribers for accuracy. The output is provided in two ways: (1) Digital Braille files (Braille-ready files like BRF or BRL) which students can read using a refreshable Braille display or on a computer with Braille support, and (2) Embossed Braille hardcopies for key textbooks or materials, produced with a high-speed Braille embosser on durable paper. For example, if "Introduction to Economics" is a 300-page print textbook, it might become roughly 10 volumes of embossed Braille. We prioritise producing Braille for materials like math/statistics content, where tactile reading of equations or tables is beneficial. Braille production follows international and Nigerian Braille standards (BANA guidelines for literary Braille, Nemeth Code or UEB for mathematics as appropriate). Each pilot university's resource centre will house a Braille library of commonly used texts by the project's end. Even though Braille preparation is time-consuming, it is invaluable for building literacy and note-taking skills among blind students.

Audio Format (Synthetic and Human-Narrated)

We provide audio versions of materials to cater to students who learn best by listening. Our approach leverages high-quality text-to-speech conversion and human narration in some cases. Using the EVISVision TTS engine and other software, we generate audio files (MP3 or DAISY audio books) for textbooks and lecture notes. These automated readings are quick to produce and can be easily updated if the source text changes. We also employ human narrators to record audiobooks for particularly complex or narrative-heavy texts (for instance, literature readings or materials where tone is important). We partner with volunteer reader programs and radio/television voice artists to record

chapters of select texts in clear, expressive speech. All audio materials include structured navigation (e.g. the ability to skip by chapter or section, especially in DAISY format). Students can either listen through the EVISVision app or via any MP3 player. The audio format allows students to study while commuting or resting, and can be a less intensive way to absorb large volumes of text. It addresses the finding that assistive technology can help with reading and writing challenges, enabling students to engage with content in a mode that suits them (Okoye, 2024). The project expects to produce dozens of hours of instructional audio content, benefiting others with reading difficulties.

Large Print and High-Contrast Materials

We create large-print versions of documents for low-vision students (those with some usable vision but who need magnification). Using desktop publishing tools, we reformat textbooks or handouts into large font sizes (e.g. 18-24 point) with high-contrast colour schemes (typically white text on black background or black on pale yellow, depending on user preference). These are PDF files optimised for screen magnifiers or printed on paper for shorter handouts. We ensure that diagrams or images in the material are enlarged and clarified with good contrast. Large-print materials help partially sighted students who might find Braille unfamiliar and prefer to use their residual vision. Additionally, we encourage using tactile graphics where appropriate: diagrams, maps, or charts are reproduced using swell paper or embossed outline drawings so blind students can feel the shapes. While tactile graphic production is specialised, we have created a few (for example, a tactile diagram of the human anatomy for a biology course, or a raised-line graph for an economics course) as prototypes. We will train staff to produce more on demand. These efforts align with recommendations that accessible formats include not just text but also graphical information in tactile form (CAST, n.d.).

Screen-Reader Compatible Digital Files

Ensuring electronic documents are structured adequately for screen reader software is vital to our process. This includes producing EPUB3 or DAISY text versions of textbooks, which are essentially e-books with built-in accessibility. For instance, an EPUB3 file can contain headings, navigation landmarks, alt-text for images, and descriptions, allowing a blind student to jump to chapters or have figures described easily. DAISY (Digital Accessible

Information System) books provide a similar navigable structure, often used in specialised talking book libraries. We have converted materials into accessible Word and PDF formats, tagging headings, lists, tables, and adding descriptions to images so that commonly used screen readers (like NVDA or JAWS) can interpret them correctly. This ensures that students who prefer using their laptop with a screen reader can read the material without obstacles. According to the National Centre on Accessible Educational Materials, examples of accessible formats include "audio, braille, large print, tactile graphics, and digital text conforming with accessibility standards" (CAST, n.d.) Our project covers all of these. Screen-reader-friendly e-text is perhaps the most versatile format, as it can be rendered in audio, Braille or enlarged visually depending on the user's device. We expect that the accessible digital files we create will also be shareable resources; for example, if one university converts a popular textbook into an accessible e-book, it can be distributed to others, maximising impact. Part of our process is documenting conversion workflows so university libraries can continue producing such formats beyond the project.

Workflow and Collaboration

The conversion process generally follows these steps: obtaining permission and source files from publishers (when needed) – we leverage educational exemptions and fair use provisions where possible; running OCR on print-only materials to get a base text (proofread for accuracy); formatting the text for each output (Braille translation, adding image descriptions, etc.); quality checking each format with actual users (e.g. having a blind student test-read a Braille sample or having a low-vision student review a large-print layout); and finally, dissemination of the accessible copies through a library system or the EVISVision app. We have engaged with the Accessible Book Consortium and local blindness organisations to ensure adherence to best practices and to possibly contribute our outputs to broader initiatives like Bookshare or the Marrakesh Treaty libraries. By the end of the project, the aim is not only to have created a repository of accessible academic materials in pilot subjects, but also to have established a replicable model (guidelines, training for transcribers, and possibly procurement of equipment like Braille embossers) so that each institution can continue converting new materials each semester.

Conclusion

Promoting inclusive higher education for students with visual impairments requires more than policy declarations; it demands deliberate investment in accessible technologies, inclusive pedagogical practices, institutional commitment, and sustained stakeholder collaboration. This paper presented a comprehensive framework for addressing barriers faced by visually impaired students within Nigerian universities through the integration of assistive technology development, educator training, accessible learning materials, and policy advocacy.

The proposed EVISVision application demonstrates how locally relevant technological innovations can enhance independent learning and improve access to educational resources. Similarly, the conversion of academic materials into accessible formats and the strengthening of educator competencies can significantly improve participation and academic success among students with visual impairments.

For sustainable impact, universities should institutionalise disability support services, allocate adequate funding for assistive technologies, and incorporate inclusive education principles into strategic planning and staff development programmes. Policymakers should also strengthen the implementation of existing disability and inclusive education policies to ensure equitable access to quality higher education.

Ultimately, achieving an inclusive university system in Nigeria is both a social justice imperative and a developmental necessity. By removing barriers and expanding educational opportunities, Nigerian universities can create environments where students with visual impairments are empowered to realise their full academic and professional potential.

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CHAPTER FOURTEEN

Reimagining Leisure Education Through Freire: A Comprehensive Guide

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Abstract

This paper examines Paulo Freire's Pedagogy of the Oppressed as a transformative framework for leisure and recreation education. Traditional pedagogical approaches in leisure studies remain rooted in hierarchical, banking models that reinforce systemic oppression, including Whiteness, monoculturalism, and exclusion. Drawing on Freire's concepts of critical consciousness, dialogical action, and problem-posing education, we argue that leisure educators must move beyond performative inclusion toward genuinely liberatory practices. We analyse how current pedagogies perpetuate oppression through White Institutional Presence and anti-dialogical actions such as conquest, divide and rule, manipulation, and cultural invasion. We then demonstrate how Freirean dialogical actions, cooperation, unity, organisation, and cultural synthesis can address these inequities through co-creation, praxis, and decolonised pedagogy. Practical strategies include co-designed syllabi, community-engaged projects, and integration of Indigenous knowledge systems. By cultivating critical consciousness and embedding dialogical action, leisure educators can position education as a practice of freedom, challenging dominant ideologies and creating more inclusive, just learning environments.

Keywords: Critical Pedagogy, Freirean Dialogical Action, Leisure Studies, Whiteness and Praxis

Introduction

In recent years, educators across many fields have started to question traditional teaching methods. They have asked whether old approaches actually help students learn or whether they simply maintain unfair systems. Critical pedagogies offer teachers meaningful ways to connect with students through their real-life experiences. These approaches can create learning environments that include everyone and help set people free. However, in the field of leisure and recreation studies, most teaching still follows old patterns. Teachers talk, students listen.

Knowledge flows in one direction. Content is standardised and does not account for different backgrounds and experiences. This absence of critical frameworks is not neutral. It actually reinforces systems of oppression that are built into higher education itself. These systems include Whiteness, monoculturalism, and exclusion (Anderson et al., 2021; Mowatt, 2017).

Many scholars have written about these problems. Rose and Paisley (2012) and Theriault (2023) have pointed out how leisure education often ignores race and power. They have shown how traditional methods can hurt students from marginalized backgrounds. But while the literature has grown, few works have offered specific teaching approaches to counter these problems (Fernandez et al., 2022). This gap matters because identifying problems without offering solutions can leave educators feeling stuck. They may want to change but not know how. This paper aims to fill that gap by examining Paulo Freire's famous book *Pedagogy of the Oppressed* as a framework for reimagining leisure education. Freire was a Brazilian educator who developed his ideas while teaching poor adults to read in the 1950s and 1960s. He saw education as a practice of freedom rooted in dialogue, reflection, and action. His work provides powerful tools for confronting dominant ideologies and centering student agency.

We argue that leisure and recreation educators must move beyond performative inclusion efforts. It is not enough to add a few diverse readings to the syllabus or to mention inequality in passing. Instead, educators need to adopt teaching practices based on Freirean principles. This means fundamentally rethinking the relationship between teacher and student. It means creating classrooms where knowledge flows in both directions. It means treating students as whole human beings with valuable experiences and insights. We will draw connections between Freire's theory and common practices in leisure classrooms. We will critically examine how current approaches perpetuate oppression. We will then show how Freire's work can lead to more just and transformative models of teaching and learning. Our analysis concludes by offering specific strategies for embedding dialogical action into leisure education. The goal is to cultivate critical consciousness in students and create systemic change in the field.

Understanding Paulo Freire's Pedagogy of the Oppressed

To apply Freire's ideas to leisure education, we first need to understand what he actually taught. Paulo Freire was not just an academic philosopher. He was a practitioner who worked directly with oppressed communities. He saw education not as a neutral activity but as a political act that could either maintain or challenge existing power structures. His most famous book, *Pedagogy of the Oppressed*, was first published in Portuguese in 1968, and the English translation appeared in 1970. It

has since become one of the most influential works in educational theory. The book addresses the tension between freedom and the means through which freedom is achieved. At the heart of Freire's work is the concept of *conscientização*, or critical consciousness. Through critical consciousness, oppressed people become aware enough of their oppression to question and fight their reality. This awareness is not just intellectual. It is practical and emotional. It moves people from passive acceptance to active resistance.

Freire (1970) begins his book by examining what it means to be human. He argues that systems of oppression hinder human development. The oppressor tries to reduce the oppressed to less than human. The oppressed, in turn, see themselves as inferior and self-deprecating. This dynamic is destructive for everyone involved. However, both groups need each other to change this situation. The oppressor cannot truly help the oppressed without their involvement. The oppressed must be full participants in their own liberation. And in doing so, they also liberate their oppressors from their own dehumanisation. Freire (1970) writes that "the pedagogy of the oppressed is an instrument for their critical discovery that both they and their oppressors are manifestations of dehumanisation" (p. 48). He also makes clear that the oppressed must enter into reflection and critical consciousness as full human beings, not as objects. They are not problems to be solved, but people with agency and dignity.

In the second chapter, Freire outlines two distinct pedagogical models. The first is the banking model of education. This model assumes that learners are empty vessels ready to be filled by the teacher with knowledge and facts. The teacher deposits information, and the student receives it passively. Freire (1970) believes this pedagogy keeps students oppressed. It stifles their curiosity and creativity. It rewards meekness and receptivity. Students learn to accept authority without question. The banking model may seem inclusive because it offers education to everyone. But the content of banking often conflicts with the lived experiences of oppressed people. It presents a single-sided view of knowledge that normalises their lack of humanity. Students may be educated, but they are not liberated. They simply learn to fit into the existing system.

The second model is the problem-posing model of education. This is what Freire refers to as critical pedagogy. Instead of depositing knowledge, this method focuses on cognitive interactions between the teacher and learners. Knowledge is co-created. The flow of knowledge is reciprocal. Teachers and students teach each other. This dynamic process is only possible through dialogue. Freire (1970) writes that "problem-posing education affirms men and women as beings in the process of becoming, as unfinished, uncompleted beings in a likewise unfinished reality" (p. 84). This highlights the power of education as a means of liberation. It treats humans as always growing and changing. It also treats reality as something that can be

transformed. This model increases humanity and, as Freire often mentions, is an act of love.

The third chapter explores the key concepts of dialogic and anti-dialogical methods, the use of praxis, and thematic investigation. Freire believes these concepts are prerequisites for meaningful problem-posing education. Dialogue, for Freire, is not just conversation. It is "the encounter between men, mediated by the world, in order to name the world" (Freire, 1970, p. 88). Through dialogue, humans name their reality and enter into the process of becoming more fully human. The prerequisites for dialogue are love for the world, humility, faith, trust, hope, and critical thinking. Dialogue is positioned as the action associated with liberation. It is not a means to convince the oppressed to take action. It is itself a liberating act.

Freire (1970) also emphasises the need for thematic investigation before dialogical education can commence. Teachers must understand students' reality. Only then can they provide meaningful education. With an understanding of reality, teachers can help students investigate their own situation. This new awareness of limit-situations enables students to view their themes or situations as problems ripe for further investigation. They can see that their circumstances are not fixed but can be changed. This awareness is the foundation for action.

The fourth and final chapter lays out Freire's cultural action theory. He contrasts the methods of cultural change with cultural oppression by describing the theories of dialogical and anti-dialogical actions. The methods of anti-dialogical action include conquest, divide-and-rule, manipulation, and cultural invasion. Conquest aims to mythologise the world to maintain the status quo. It repeats to the oppressed the belief that the world is fixed and cannot change. Divide and rule focuses on helping individuals escape oppression rather than uniting people as a group. Individuals are lifted out of oppression only to return to their communities to propagate control. Manipulation asserts the possibility of class ascent. It distracts the oppressed from the reality of their oppression by promising them the chance to become elite. Cultural invasion imposes the ideas and values of the oppressor elite on the oppressed. It convinces the oppressed that their own ideas and values are inferior.

Freire (1970) then contrasts these with dialogical actions. These include cooperation, unity, organisation, and cultural synthesis. Cooperation exists only through communication. It utilises dialogical methods and problem-posing education, which leads to critical analysis of reality. Unity refers to the union of revolutionary leaders with the oppressed. This is resolved through praxis, the dialogue of thought that leads to liberating action. Organisation is a process that requires freedom and authority. It is established by transforming reality. Finally, in cultural synthesis, the leader's

worldview and the people's worldview are reconciled. The culture itself is confronted, and integration of the people toward action and liberation occurs.

Problematic Pedagogies in Leisure Education

The implementation of Freirean pedagogy in leisure and recreation studies offers opportunities to counter problematic pedagogies. These problematic pedagogies are connected to Freire's anti-dialogical action theory. They represent oppression in education. Central to these problematic pedagogies is the ideology of Whiteness, which is embedded in many structures of higher education. This ideology aligns closely with Freire's concept of the oppressor class. It highlights the dominant, pervasive systemic impact on education.

Scholars have developed frameworks to understand how Whiteness operates in higher education. Gusa (2010) uses the ideologies of Critical Race Theory, the worldview of Whiteness, and White privilege to construct their framework of White Institutional Presence (WIP). This framework has four characteristics: White ascendancy, monoculturalism, White blindness, and White estrangement. These four characteristics align with Freire's anti-dialogical theory of cultural oppression. Each one represents a way that white supremacy is maintained through educational practices. Understanding these characteristics is essential for leisure educators who want to create more just classrooms.

White ascendancy describes the opportunities and positions that a white sense of superiority can attain and maintain. In Freire, this is exemplified by manipulation, in which the oppressor convinces the oppressed of their ability to ascend to the elite class. We observe this conundrum in leisure and recreation studies. The continued use of certain narratives and pedagogies necessitates adaptation to be successful in the field. Several examples illustrate this point. The juxtaposition of wilderness and the use of natural spaces often reflect white values. The use and importance of challenge, as well as physical and social discomfort, also stem from white perspectives. The assumptions of leisure time and freedom ignore the reality that many people do not have the same access to free time or safe spaces (Peterson & Chenault, 2023).

Scholars have critically examined how dominant narratives in outdoor education are rooted in Whiteness. Ho and Chang (2022) examine how narratives tied to wilderness, risk, and self-discovery often exclude or alienate people of colour. Leisure spaces are framed as belonging to an imagined, racially neutral outdoors. But this neutrality is a fiction. Concepts like nature or wilderness function as gatekeeping tools. They limit access and a sense of belonging for marginalised communities. When educators treat these concepts as universal, they reinforce white ascendancy

without even realising it. Rose and Paisley (2012) similarly argue that outdoor education must critically examine its white-centered assumptions.

Monoculturalism describes the uniform set of values and beliefs embedded in white culture. These stifle true diversity in both scholarly work and campus climates. In Freire, this is described as cultural invasion. Cultural invasion similarly stifles creativity and diversity of ideas among the oppressed. The values and beliefs of the oppressors become predominant. Those of the oppressed are often viewed as inferior. In leisure studies, monoculturalism appears in how experiences are understood and constructed. Kivel and colleagues (2009) apply the concept of monoculturalism in leisure through a discussion of how the understanding and meaning of experiences in leisure are constructed. Researchers often use constructivist approaches that focus on the majority of people's perspectives. They ignore or marginalize other ways of knowing. These ideas are grounded in Gramsci's theory of hegemony (Cassar, 2017). Hegemony shows how dominant ideologies control narratives by continuing practices of exclusion and inequities under the cover of freedom and choice.

In an outdoor setting, monoculturalism is exemplified through the values that guide our interactions with nature and wilderness. Land-use ethics taught to practitioners often reflect white perspectives. Indigenous ways of relating to the land are ignored or treated as lesser. This imposes a single worldview on everyone. It tells students that there is only one correct way to think about nature, recreation, and leisure. This is cultural invasion in practice.

White blindness describes the tendency for race to be erased. With this erasure comes a lack of acknowledgement of racism. In Freire, we see the concept of conquest, which aims to mythologise the world as a fixed entity (DeBrew et al., 2024). When the oppressed cannot see their existence as anything but the current perceived reality, they cease to imagine anything different. This blindness to their own oppression is characteristic of the purpose of conquest. In leisure and recreation, this blindness is frequently seen in the perpetuation of Whiteness ideologies. It appears in the design and implementation of programs. It appears in the membership of organisations (Carter & Rose, 2024). Race is simply not discussed. Problems are attributed to individual failures or bad luck rather than systemic racism.

White estrangement describes campus environments where physical and social separation of white people further perpetuates other ideas of Whiteness. In Freire, the concept of divide and rule is the acceptance that oppressor ideologies allow adopters to be lifted out of oppression. But this happens only as individuals. And those individuals lose touch with their own characteristics of oppression. They become isolated from their communities. Leisure and recreation in outdoor spaces have a long history and association with Whiteness. Davis (2018) points out that policies such as

the Wilderness Act of 1964 marginalised African American communities. They privileged elite white ideas of nature and erased Black participation in outdoor spaces. Ideas about wilderness exploration, land use, conservation, and nature access all have their roots in white settler colonialist ideas (Carter & Rose, 2024; Ho & Chang, 2022).

Scholars have critiqued white approaches in leisure studies. Mowatt (2017) critiques the White approaches in leisure studies, which fail to account for the historical and ongoing impacts of colonialism and racism on access and participation. Mowatt (2017) calls for a critical expansion of leisure theory by centering racialized histories of land, recreation, and public space. Leisure studies often treat race as an afterthought. It assumes a universal subject position that erases Black and Indigenous experiences. This erasure is not accidental. It is a result of white estrangement, where people are separated from each other and from their histories.

Based on this analysis, we assert that the study and field of leisure and recreation are not exempt from these frameworks. It is part of the higher education landscape. It must therefore seek methods to address change within these four characteristics. We will now explore how Freire's concepts of dialogical action can be used to address these problematic pedagogies.

Applying Freire's Dialogical Actions to Leisure Studies

Freire offers specific approaches through dialogical actions to address systemic inequities. Dialogical actions promote active engagement among individuals. They enable people to understand different perspectives. They foster dialogue that co-creates knowledge and works toward shared goals. These actions ultimately lead to social change or personal transformation. Actions such as cooperation, praxis, and cultural synthesis provide pathways for transformative movements toward equity in leisure and recreation studies. Freire's philosophy presents significant implications for challenging dominant pedagogical practices that reinforce Whiteness, monoculturalism, and exclusion.

Many social science researchers have already highlighted ways to address these systemic inequities. Their work complements Freire's dialogical action theory. Scholars such as bell hooks (1994) and Henry Giroux (1997) have contributed to critical pedagogy in education. They advocate for teaching practices that empower marginalised students and challenge oppressive structures. In *Teaching to Transgress*, hooks (1994) emphasises the importance of engaged pedagogy. This approach centres critical thinking and values the experiences of students, particularly those from marginalised backgrounds. hooks (1994) argues that education should serve as a practice of freedom. It should encourage students to challenge societal norms and become agents of change. This understanding aligns closely with Freire's

belief in education as a tool for liberation. Dialogue and reflection enable students to critically engage with their lived realities. This is the concept of *conscientização*.

Giroux (1997) similarly emphasises the political nature of education. He advocates for teaching that actively addresses social justice issues. He critiques the notion of neutrality in education. Such neutral actions often reinforce existing power structures. Giroux's perspective echoes Freire's critique of the banking model of education. To address this banking model, Freire suggests adopting a dialogical method that emphasizes the co-creation of knowledge. This counteracts oppressive dynamics by centering the voices and experiences of marginalized groups. It ensures that education does not perpetuate racialized hierarchies.

Scholars like Anderson and colleagues (2021) also contribute essential insights. Educators must be critically reflective in practice. This applies even to well-intentioned aims of volunteerism or diversity initiatives. They must recognise leisure as a contested space. Anderson et al. (2021) critique what they call the White Saviour Industrial Complex. In this complex, service-oriented project, the emotional satisfaction or learning experiences of white students are often prioritised over genuine community empowerment. Without critical reflection on power, privilege, and positionality, such engagements can reinforce the very hierarchies they seek to dismantle. Their work calls for pedagogical practices that are dialogical, rooted in praxis, and attentive to race and power. This makes their work an essential addition to Freire's philosophy. Educators can facilitate discussions on how power operates in recreational settings. They can empower students to question and resist these dynamics. Embedding dialogical actions into pedagogical frameworks opens opportunities for educators to create inclusive spaces that promote critical consciousness and foster liberation.

Co-Creation as a Foundation for Justice

Freire emphasises that co-creation and problem-posing education can be tools for dialogical action. Co-creation and problem-posing open the possibility for critical engagement among oppressed communities. They also enable critical discourse on issues in leisure and recreation studies (Dustin et al., 2019). Co-creation is fostered through problem-posing, facilitated by the educator. But the educator is in service to the shared analysis and interrogation of experience. These practices can validate diverse perspectives. They can challenge hegemonic narratives of whiteness in educational settings (Rose & Paisley, 2012).

In the context of leisure studies, co-creation necessitates a rethinking of the educator-student relationship. This rethinking is not just symbolic. It requires concrete changes to how courses are designed and taught. Classes may start with a co-design phase in which students are encouraged to share their learning outcomes. This creates a

platform to practice critical engagement. Knee and Thomas Means (2018) argue that classes may begin with a co-design phase in which students are encouraged to share their learning outcomes. For example, instructors might begin the semester with a co-designed syllabus activity. Students collaboratively identify key social justice themes they want to explore. These might include access to green spaces, the history of exclusion in parks, or the impact of gentrification on recreation opportunities. Students then help shape assignments that allow them to critically engage with those themes. This could involve reflective writing, community-based projects, or research papers.

Another example could involve students co-creating evaluation rubrics for group work or presentations. This centres mutual respect, diverse perspectives, and shared responsibility. It embodies Freire's commitment to dialogical relationships and shared meaning-making. Students have a voice in how they are evaluated. They learn to think critically about what counts as good work. They also learn to negotiate and collaborate with their peers. This is not a simple process. It can be messy and challenging. But that is part of the point. Education should not be about comfort. It should be about growth.

Central to these examples is the idea that co-creation begins with educators considering how to incorporate student voice and choice into course design. This might mean flexible deadlines, multiple assignment options, or student-led discussions. It means trusting students to take responsibility for their own learning. It also means being transparent about power dynamics. Educators should acknowledge that they have authority in the classroom. But they can choose to share that authority. They can invite students to be partners in the learning process.

Co-creation also extends beyond the classroom. Students can co-create programs with community partners. They can work with local organisations to design inclusive recreation programs. This requires genuine collaboration, not just token involvement. Educators should facilitate these partnerships carefully. They should ensure that community voices are centred, not just student learning. They should also help students reflect on their own positionality. This is not just about learning skills. It is about becoming more thoughtful, aware, and ethical practitioners.

Building Collective Agency through Praxis

To counter the divide-and-rule practice, Freire describes the path of unity, grounded in praxis. Praxis is the process of reflection and action aimed at transforming oppressive structures. In leisure studies, unity can be achieved through collaborative projects that address systemic inequities within the field. This perhaps begins with the thematic investigation of the students and educators themselves. They need to better understand their positionality with respect to local communities and systems of

power and oppression. This process may be inherently emotional. Therefore, integrating the work of Schultz and colleagues (2022) on emotional pedagogies can be useful when unpacking positionality and privilege in the context of social justice in leisure education.

Students and educators can then purposefully engage with local communities to design programs that address issues. These might include economic access or historical exclusion from public spaces. For instance, a group project might involve students partnering with a local nonprofit to design inclusive recreation programs for historically excluded populations. As students research barriers to participation and listen to community narratives, they engage in reflection. This is a thematic investigation. They then apply what they learn through collaborative program design. This is action. The educator, meanwhile, participates as a co-learner. They guide but do not dictate. They help students navigate ethical questions, positionality, and impact. This collaborative and critical approach provides the opportunity to engage in praxis. Students identify systemic issues and take collective action to address them. This is far better than perpetuating structural inequities through isolation and spectatorship. Unfortunately, isolation and spectatorship have been institutionalised and practised by educators for too long (Theriault, 2023).

Caution should be taken when shifting from praxis to action and seeking to engage in community work. As Anderson and colleagues (2021) write, particularly for white students and educators, they must "be aware of the historical and structural barriers that have caused the problem they seek to address, their own membership in the hegemonic group that has built or benefited from those barriers, and the complexities associated with accepting recognition for their efforts" (p. 546). This awareness is crucial. Without it, well-intentioned projects can do more harm than good. They can reinforce the very systems they aim to dismantle.

With awareness of the larger implications of action, grounded in thematic investigation prior to praxis and action, collaboration and a critical approach make education a catalyst for collective liberation. This aligns with Freire's vision of education. It is not about individual advancement. It is about collective transformation. It is about building power together to change oppressive structures. This is hard work. It requires patience, humility, and persistence. But it is the only path to lasting change.

Decolonised Pedagogy through Cultural Synthesis

Cultural synthesis promotes the integration of diverse worldviews through dialogue and respect. Freire offers a framework for decolonising education through cultural synthesis. This treats different cultures equally and gives them equal authority. It is the opposite of cultural invasion, which imposes the oppressors' values onto the

oppressed. In leisure studies, dominant narratives often marginalise non-Western perspectives (Carter & Rose, 2024). For example, instead of teaching concepts of wilderness from white Eurocentric narratives, educators in leisure studies can integrate Indigenous knowledge systems. Kimmerer (2013) provides a holistic understanding of human-nature relationships by highlighting interconnections between land, culture, and identity.

A practical application might involve inviting Indigenous community members into the classroom. They can co-facilitate sessions on traditional ecological knowledge. Students can then engage in student-led reflections that connect these teachings to their own cultural assumptions about wilderness. This is not a one-time event. It should be an ongoing relationship built on trust and respect. Alternatively, an assignment might involve students comparing land-use ethics from multiple worldviews. This could go beyond the common preservationist-versus-conservationist dichotomy. Students might compare Western Leave No Trace principles with Indigenous relationality with the land. They could discuss the implications for their future practice. What does it mean to be a recreation professional who respects multiple ways of knowing? What does it mean to challenge dominant narratives in their own work?

Cultural synthesis is not about appropriating Indigenous knowledge. It is about respecting it as equally valid. It is about recognising that Western knowledge is not the only knowledge. It is about creating space for other voices to be heard. This requires humility and a willingness to learn. It also requires action. Educators should not just talk about decolonisation. They should change their curricula and teaching practices. They should seek out partnerships with Indigenous communities. They should support Indigenous scholars and practitioners. They should challenge institutional policies that maintain white supremacy.

Cultural synthesis also applies to other marginalised perspectives. Leisure educators should include voices from Black, Latinx, Asian, and other communities. They should teach about the histories of exclusion and resistance in leisure spaces. They should help students understand that leisure is not neutral. It is shaped by race, class, gender, and other systems of power. By doing this, educators help students become more critical and aware practitioners. They prepare students to work in diverse communities. They also prepare students to challenge injustice in their own fields.

Conclusion

Freire, in *Pedagogy of the Oppressed* (1970), outlines the systemic issues used by the oppressor to maintain control over the oppressed. To continue exploitation, the oppressor employs tactics that deceive the oppressed into believing in their own nobility. White Saviour is an example where, instead of addressing the root structural

cause, white people offer momentary consolation to keep control over marginalised people (Anderson et al., 2021). Freire offers dialogical actions such as cooperation, praxis, and cultural synthesis as practical tools. These counter oppressive practices and offer a practical approach to integrating theories into practices that can lead to social change and liberation.

Leisure educators should adopt Freire's framework as a theoretical foundation to guide transformative practices. They should move away from banking models of instruction. They should move toward co-created learning experiences that centre on students' lived experiences and community engagement. Educators should critically reflect on their positionality. They should intentionally cultivate dialogical classrooms where knowledge flows bidirectionally. Institutions should support pedagogy that challenges dominant ideologies, including Whiteness and monoculturalism. They should create space for multiple epistemologies to thrive. This means changing policies, hiring practices, and evaluation criteria. It means supporting faculty who do this work. It means valuing community engagement and social justice as much as traditional research.

By cultivating critical consciousness and embedding dialogical actions into their teaching, leisure educators can position education as a liberatory force. This commitment to reflection and co-created action enables educators and institutions to challenge oppressive structures. It creates an inclusive future aligned with Freire's vision of education as liberation. In doing so, educators affirm the humanity of their students and themselves. They help co-create a more inclusive and just future for the field. This is not easy work. It requires ongoing effort and learning. But it is essential for creating a field that truly serves all people. It is essential for building a world where everyone can experience the freedom and joy of leisure.

The path forward is clear. Educators must embrace Freire's vision. They must commit to dialogue, reflection, and action. They must challenge oppressive structures in their classrooms and beyond. They must centre the voices of marginalised communities. They must be willing to learn and change. This is the work of liberation. It is the work of love. And it is the work that leisure educators must undertake if they want to create a more just and inclusive world.

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CHAPTER FIFTEEN

Evaluation of Leaf Morpho-Anatomical and Fibre Quality and Characterisation of *Luffa Cylindrica* (L.) M. Roem. And *Luffa Acutangula* (L.) Roxb.

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Abstract

Luffa, a genus of tropical and subtropical vines in the cucumber family, shows morphological variation influenced by environmental factors. However, scientific data on the thermal and mechanical properties of *Luffa* fibres remain limited. This study investigated the leaf morpho-anatomical characteristics and fibre quality of *Luffa cylindrica* and *Luffa acutangula*, using mature fruits collected from eight local government areas in Kwara State, Nigeria. Seeds were cultivated in a randomised complete block design. Morphological analysis revealed greater variability in *L. cylindrica* for stem girth, leaf size, and qualitative traits. Anatomically, both species were amphistomatic, with *L. cylindrica* bearing trichomes on both surfaces, unlike *L. acutangula*. Mechanical testing showed that *L. cylindrica* had superior tensile strength, modulus, flexural strength, and hardness, whereas *L. acutangula* exhibited higher impact energy and elongation. These findings suggested *L. cylindrica* is better suited for industrial fiber applications, supporting the need for its cultivation and promotion for commercial use.

Keywords: Luffa cylindrica, Luffa acutangula, Fibre quality, Anatomy.

Introduction

Species of the genus *Luffa* belonging to the family Cucurbitaceae are widely cultivated in tropical and subtropical regions for food, fiber, and industrial purposes (Cheng *et al.,* 2020). They are significant vines known for their economic value majorly from their fruit, which upon maturation and drying, yields a fibrous network natural sponge like fiber (Barirega & Van Damme, 2014). It has also been reported to be used for various applications such as tissue for engine filters, steel helmet lining, insulation, packing materials and

filters in factories. In Nigeria, *Luffa cylindrica* (smooth loofah) and *Luffa acutangula* (ridged loofah) are the most commonly cultivated species. They are known for their adaptability and diverse uses, particularly as scrubbing sponges and reinforcement in composite materials (Wambua *et al*., 2003). Despite their uses, taxonomic delimitation, especially between *L. cylindrica* and *L. acutangula*, remains ambiguous due to their morphological similarities and interspecific hybridisation potential (Heiser & Schilling, 1990; Bal *et al*., 2004). The Luffa species are influenced by a complex interplay of genetic factors and environmental conditions (Widen & Sheinmann, 2006). Understanding this variation is important for germplasm classification and identification of superior genotypes for specific applications. In addition, the anatomical information of the leaves and stems can provide significant taxonomic insights.

As Nigeria explores bio-based resources due to interest in sustainable, renewable and biodegradable materials, this has increased the search for the potential of natural fibres to replace synthetic ones in various applications. Luffa fibres, a natural, readily available and relatively expensive fibers, have been looked into as a possible alternative (Mohanty *et al*., 2000). However, a comprehensive understanding of the morpho-anatomical and mechanical properties of Luffa species is critical for their optimal utilisation in bio-composites, textiles, and agro-industrial applications.

It is well documented that morphological traits have always been central to plant taxonomy (Zaman *et al*., 2025), but recently, leaf epidermal features and anatomical markers have been used to resolve ambiguities (Mbagwu & Edeoga, 2006). Luffa's fibrous vascular endocarp has attracted interest for use in industrial composites due to its biodegradability and high cellulose content (Tanobe *et al*., 2005). However, environmental conditions and genetic variability influence their mechanical properties (Siqueira *et al*., 2010). A comparative analysis of different species, particularly those cultivated in different geographical regions like Nigeria, remains limited and, therefore, necessitates region-specific characterisation studies of Luffa. The study aimed to address the gap by conducting a detailed investigation into the morpho–anatomical characteristics and fibre quality of Luffa cylindrica and Luffa acutangular accessions collected and cultivated in Kwara State, Nigeria.

Materials and Methods

Mature dry fruits of 20 accessions of *Luffa cylindrica* (18) and *Luffa acutangula* (2) were collected from eight (8), selected randomly from the sixteen (16) different local government areas with different provenances and settlements within Kwara State, Nigeria (Table 1). Voucher specimen were deposited, identified and authenticated at the herbarium, Department of Plant Biology, Faculty of Life Sciences, University of Ilorin. Seeds were extracted from the collected fruits and cultivated at the Botanical Garden of University of Ilorin using a randomised complete block design with three replicates per accession. Standard agronomic practices were followed to ensure optimal growth.

Morphological Characterisation: Morphological quantitative traits data including stem girth, leaf length and width were measured at seedling and maturity stages, using standard protocols (Radford *et al*., 1974). Qualitative traits including leaf colour, flower colour, fruit shape and seed characteristics were visually assessed and recorded, using descriptive terminology based on established description (Zalapa *et al*., 2006)

Anatomical Studies: Leaf peels sample from fully expanded mature leaves of all the *Luffa* accessions were prepared using nitric acid maceration. Epidermal peels obtained were stained with safranin. Stomatal density, length, width, size, index, and type and epidermal density and shapes were assessed with light microscopy (Khan *et al*., 2017).

Fiber Testing: Mature dry fruits of *Luffa* accessions were processed to extract the fibrous vascular network. The fruits were retted for several days to enhance removal of outer skin and pulp. Resulting fibrous sponges were then thoroughly washed, dried and cut into test specimen of uniform dimension. Mechanical tests (tensile strength, strain, flexural strength, hardness, elongation, impact energy) were conducted on retted and dried fruit fibers. Six (6) accessions of already retted and air-dried *Luffa* species were randomly selected, pulverised and analysed for percentage chemical composition

Table 1: *Luffa* Species Accession Code Numbers, Location of Acquisition and GPS Coordinates

Accesssion code No	Location	GPS Coordinates
01 OGD	Ogidi, IL-West	8.21' N, 4.26' E
02 UIL	Unilorin Garden, IL-South	9.54' N, 4.45' E
03 AGB	Agbooba Area, IL-West	8.43' N, 4.50' E
04 ADW	Adewole Estate, IL-West	8.51' N, 4.42' E
05 SHK	Sheik Abdulkadri College, IL-West	8.29' N, 4.46' E
06 APL	Apalara Area, IL-West	8.25' N, 4.39' E
07 OKF	Okefoma Area, IL-West	8.40' N, 4.42' E
08 ARP	Airport Road,IL-West	8.49' N, 4.59' E
09 ALG	Alagbado Hospital, IL-South	9.40' N, 5'00' E
10 OKL	Okelele Area, IL-East	10.28' N, 5.07' E
11 AGS	Agric Sango, IL-South	9.43' N, 4.20' E
12 KSU	Kwasu Malete, Moro	9.64' N, 4.99' E
13 OLJ	Oloje Estate, IL-West	8.39' N, 4.19' E
14 OKY	Okeoyi, IL-East	10.26' N, 5.04' E
15 OFG	Offa Garage, IL-South	9.86' N, 4.95' E
16 OKS	Oke Ose, IL-East	10.85' N, 4.69' E
17 OMP	Omupo, Ifelodun	9.04' N, 4.98' E
18 OFF	Offa COHT, Offa	9.92' N, 4.95' E
19 EIY	Eiyenkorin, Asa	9.45' N, 4.47' E
20 AJS	Ajasepo ipo, Irepodun	10.04' N, 4.80' E

Note: - 14 OKY and 15 OFG are *luffa acutangula* while other accessions are *luffa cylindrical*

Data Analysis

Data obtained from morphological measurements, anatomical studies and fibre testing were analysed, using ANOVA on SPSS version 25 to determine significant differences. Significant post hoc test using Duncan Multiple Range Test (DMRT) were also conducted to identify specific between the means.

Results

Morphological Variation

The morphological analysis revealed significant variations between *L. cylindrica* and *L. acutangula*. L. cylindrica exhibited a larger range of stem girth (5.39 to 7.52 cm), leaf length (11.10 – 16.50), leaf width (7.37 – 13.03) compared to L. acutangular with stem girth (4.20 -6.49), leaf length (9.95 – 10.60) and leaf width (7.33 – 9.33) (Tale 2). Statistical analysis indicated significant differences ($p < 0.05$) for these quantitative traits between the two species. Qualitatively, *L. cylindrica* displayed black, brown and oblong seeds while *L. acutangula* exhibited grayish black and ovate seeds (Table 3). L. cylindrica showed dark green leaves with bright yellow flowers and elongated cylindrical fruits, whereas L. acutangula had light green leaves with light yellow flowers and elongated spindle-shaped fruits. These qualitative traits provided distinguishing features between the two species.

Anatomical Features

Anatomical examination of foliar epidermis of both *Luffa* spp studied revealed that they were amphistomatic (i.e., possessing stomata on the upper and lower epidermal surfaces) with a predominance of Staurocytic stomata. Epidermal cells wall varied between polygonal and irregular shapes, often with polygonal forms on the adaxial surface and irregular patterns on the abaxial side (Table 4). *L. cylindrica* possess trichomes on both epidermal surfaces while *L. acutangula* lacked trichomes on the lower epidermal surfaces (Figure 1 and Table 5).

Table 2: Morphological Quantitative Features of the 20 Accessions of *Luffa* Species

ACC NO	STGTH(CM)	LFLGTH(CM)	LFWDT(CM)	SLFLGTH(CM)	SLFWDT (CM)
01OGD	5.99 ± 0.32^{abcd}	16.50 ± 0.67^{a}	$13 .03 \pm 0.39^{a}$	3.97 ± 0.12^{a}	2.00 ± 0.06^{a}
02UIL	5.74 ± 1.22^{abcd}	11.10 ± 0.60^{fgh}	7.37 ± 0.56^{ef}	3.87 ± 0.18^{a}	1.92 ± 0.06^{a}
03AGB	4.72 ± 0.97^{cd}	14.97 ± 0.41^{abcd}	10.40 ± 0.49^{bc}	3.97 ± 0.27^{a}	1.92 ± 0.04^{a}
04ADW	4.38 ± 0.68^{d}	16.50 ± 0.51^{a}	10.97 ± 0.41^{ab}	4.00 ± 0.44^{a}	1.97 ± 0.07^{a}
05SHK	4.86 ± 0.48^{bcd}	14.87 ± 1.29^{abcd}	10.20 ± 0.98^{bc}	4.20 ± 0.21^{a}	1.93 ± 0.13^{a}
06APL	4.30 ± 0.65^{d}	15.73 ± 0.46^{abc}	10.00 ± 0.26^{abc}	3.83 ± 0.12^{a}	1.98 ± 0.07^{a}
07OKF	4.22 ± 0.30^{d}	14.70 ± 1.08^{abcd}	8.63 ± 1.79^{bcdef}	3.93 ± 0.22^{a}	1.83 ± 0.03^{a}
08ARP	4.26 ± 0.29^{d}	16.40 ± 0.79^{ab}	10.93 ± 0.89^{ab}	3.77 ± 0.12^{a}	2.02 ± 0.09^{a}
09ALG	3.98 ± 0.50d	13.33 ± 1.22^{cdef}	6.40 ± 0.49^{f}	3.80 ± 0.36^{a}	2.05 ± 0.23^{a}
10OKL	5.52 ± 0.82^{abcd}	14.03 ± 0.98^{abcd}	9.30 ± 1.10^{bcde}	3.67 ± 0.28^{a}	1.97 ± 0.07^{a}
11SNG	5.39 ± 0.53^{abcd}	13.47 ± 0.62^{cdef}	8.20 ± 0.89^{cdef}	3.73 ± 0.19^{a}	1.97 ± 0.09^{a}
12KSU	7.52 ± 0.97^{a}	13.93 ± 1.41^{abcd}	9.30 ± 0.75^{bcde}	3.80 ± 0.06^{a}	1.93 ± 0.09^{a}
13OLJ	7.21 ± 1.37^{abc}	12.63 ± 1.33^{defg}	9.07 ± 0.45^{bcde}	4.10 ± 0.10^{a}	1.90 ± 0.06^{a}

14OKY	6.49 ± 0.47^{abcd}	10.60 ± 0.32^{gh}	9.33 ± 0.43^{bcde}	3.63 ± 0.09^{a}	2.00 ± 0.06^{a}
15OFG	4.20 ± 0.33^{d}	9.95 ± 0.09^{h}	7.33 ± 0.64^{ef}	3.80 ± 0.06^{a}	1.80 ± 0.06^{a}
16OKS	5.20 ± 1.45^{abcd}	11.20 ± 0.68^{efgh}	7.63 ± 0.48^{def}	3.67 ± 0.17^{a}	1.98 ± 0.12^{a}
17OMP	6.41 ± 0.34^{abcd}	13.13 ± 0.56^{cdef}	8.03 ± 0.74^{cdef}	3.87 ± 0.09^{a}	1.93 ± 0.09^{a}
180FF	5.77 ± 0.98^{abcd}	14.07 ± 0.73^{abcd}	10.20 ± 0.61^{bc}	3.67 ± 0.20^{a}	1.92 ± 0.09^{a}
19EIY	6.34 ± 0.54^{abcd}	13.87 ± 0.52^{abcde}	8.10 ± 0.26^{cdef}	3.70 ± 0.29^{a}	2.03 ± 0.03^{a}
20AJS	7.34 ± 0.23^{ab}	13.67 ± 0.72^{bcdef}	9.67 ± 0.49^{bcde}	4.03 ± 0.13^{a}	1.88 ± 0.06^{a}

Mean values ± Standard errors, Duncan's Multiple range rankings of Morphological features of the 20 *Luffa* species accessions. Different letters along columns depicts significant difference at $P<0.05$. Acc. Cod. No. = Accession Code Number, STGTH = Stem girth, LFLGHT = Matured Leaf Length, LFWDTH = Matured Leaf Width, SLFLGHT = Seedling Leaf Length, SLFWDTH = Seedling Leaf Width C.V= Coefficient of Variance. ± Standard error.

Table 3 Morphological Qualitative features of the 20 accessions of *Luffa* species

Acc. No.	Leaf colour	Flower colour	Fruit shape	Seed colour	Seed shape
01OGD	Dark green	Bright yellow	Elongated and cylindrical	Black and Brown	Oblong
02UIL	Dark green	Bright yellow	Elongated and cylindrical	Black and Brown	Oblong
03AGB	Dark green	Bright	Elongated and	Black and	Oblong

		yellow	cylindrical		Brown		
04ADW	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
05SHK	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
06APL	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
07OKF	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
08ARP	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
09ALG	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
10OKL	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
11SNG	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
12KSU	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
13OLJ	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
14OKY	Light green	Light yellow	Elongated and spindle		Greyish Black		Ovate
15OFG	Light green	Light yellow	Elongated and spindle		Greyish Black		Ovate
16OKS	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
17OMP	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
180FF	Dark green	Bright yellow	Elongated cylindrical	and	Black Brown	and	Oblong
19EIY	Dark green	Bright	Elongated	and	Black	and	Oblong

		yellow	cylindrical		Brown	
20AJS	Dark green	Bright yellow	Elongated cylindrical	and	Black and Brown	Oblong

Table 4: Leaf Anatomical Features of the 20 Accessions of two *Luffa* Species

Acc. Cod. NO	Surface	STLT(mm^2)	STWT(mm^2)	STD	ECLT(mm^2)	ECWT(mm^2)
01OGD	U	10.20 ± 0.58^{abcdef}	9.00 ± 0.58^{a}	98.68 ± 6.58^{bcd}	17.60 ± 0.75^{abcde}	11.60 ± 1.21^{cd}
	L	9.40 ± 0.40^{cdefgh}	5.00 ± 0.40^{i}	44.74 ± 5.26^{ghijkl}	10.80 ± 0.49^{lmn}	11.80 ± 0.58^{cd}
02UIL	U	10.40 ± 0.51^{abcde}	6.20 ± 0.51^{fghi}	86.84 ± 3.22^{bcd}	18.20 ± 1.16^{abc}	10.20 ± 0.66^{cdeh}
	L	8.40 ± 0.75^{gh}	5.60 ± 0.75^{ghi}	22.37 ± 2.63^{l}	12.20 ± 1.20^{klmn}	8.20 ± 0.49^{ghi}
03AGB	U	8.60 ± 0.24^{gh}	5.00 ± 0.24^{i}	69.74 ± 2.63^{defghij}	19.60 ± 0.51^{ab}	11.80 ± 1.07^{cd}
	L	11.20 ± 0.58^{a}	5.60 ± 0.58^{ghi}	47.37 ± 6.3^{fghij}	14.80 ± 1.24^{defghijk}	11.20 ± 0.58^{ghi}
04ADW	U	10.20 ± 0.37^{abcdef}	7.00 ± 0.37^{efgh}	102.63 ± 7.67^{bcd}	14.40 ± 0.75^{efghijk}	12.80 ± 1.50^{bcd}
	L	8.20 ± 0.20^{hi}	5.20 ± 0.20^{i}	31.58 ± 2.46^{l}	13.40 ± 0.87^{ijklmn}	8.20 ± 0.37^{bc}
05SHK	U	11.20 ± 0.58^{a}	5.40 ± 0.58^{hi}	136.84 ± 5.26^{a}	20.40 ± 0.51^{a}	11.00 ± 0.45^{cdefg}
	L	8.40 ± 0.24^{gh}	12.20 ± 0.24^{a}	80.26 ± 6.71^{def}	15.80 ± 0.37^{cdefghij}	10.20 ± 0.20^{cdefgh}
06APL	U	9.60 ± 0.24^{bcdefgh}	6.60 ± 0.24^{efghi}	86.84 ± 3.22^{bcd}	18.20 ± 1.16^{abc}	10.20 ± 0.66^{cdefgh}

	L	8.20±0.49^{hi}	5.60±0.49^{ghi}	76.32±5.49^{defgh}	12.20±1.20^{klmn}	8.20±0.49^{ghi}
07OKF	U	10.80±0.37^{abc}	7.20±0.37^{cdefgh}	86.84±6.71^{bcd}	17.40±0.68^{abcdef}	12.80±1.66^{bc}
	L	8.60±0.40^{gh}	5.00±0.40^{i}	50.00±4.46^{efghijkl}	11.80±0.66^{klmn}	9.20±0.49^{defghi}
08ARP	U	10.60±0.40^{abcd}	7.80±0.40^{bcdef}	77.63±13.22^{defg}	18.00±1.67^{abcd}	11.20±1.24^{cdef}
	L	8.80±0.37^{fgh}	6.40±0.37^{efghi}	25.00±3.83^{l}	10.20±1.02^{n}	8.40±0.51^{fghi}
09ALG	U	10.20±0.20^{abcdef}	9.00±0.20^{b}	82.90±5.43^{cde}	18.00±1.05^{abcd}	11.80±0.86^{cd}
	L	9.20±0.20^{defgh}	7.00±0.20^{defgh}	22.37±1.61^{l}	10.60±1.12^{mn}	7.40±0.24^{i}
10OKL	U	10.20±0.20^{abcdef}	5.80±0.20^{ghi}	92.10±8.58^{abcd}	14.00±1.30^{ghijkl}	17.80±1.24^{a}
	L	8.60±0.40^{gh}	5.40±0.40^{hi}	28.95±1.61^{l}	4.40±0.24^{o}	14.60±1.60^{b}
11SNG	U	10.60±0.24^{abcd}	7.20±0.24^{cdefg}	119.74±6.38^{ab}	13.60±0.98^{hijklm}	8.80±0.49^{efghi}
	L	8.40±0.24^{gh}	6.20±0.24^{fghi}	30.26±3.35^{l}	14.20±1.74^{fghijk}	10.40±0.51^{cdefgh}
12KSU	U	11.20±0.37^{a}	8.00±0.37^{bcde}	100.00±9.16^{bcd}	17.80±0.73^{abcd}	10.40±1.69^{cdefgh}
	L	8.60±0.40^{gh}	5.40±0.40^{hi}	25.00±3.83^{l}	10.60±0.40^{mn}	8.80±0.58^{efghi}
13OLJ	U	11.00±0.45^{ab}	9.40±0.45^{b}	92.11±9.30^{bcd}	16.80±1.11^{bcdefgh}	11.20±0.37^{cdef}
	L	8.80±0.20^{fgh}	5.40±0.20^{hi}	42.10±5.34^{hijkl}	14.20±1.07^{fghijk}	8.40±0.51^{fghi}

14OKY	U	8.20±0.37^{hi}	5.40±0.37^{hi}	72.37±2.94^{defghi}	15.60±0.87^{cdefghij}	9.20±0.49^{defghi}
	L	7.00±0.45^{i}	6.40±0.45^{efghi}	34.21±4.83^{kl}	13.20±0.73^{jklmn}	10.80±0.37^{cdefgh}
15OFG	U	8.40±0.40^{gh}	7.20±0.40^{cdefg}	68.42±3.36^{defghijk}	14.00±0.71^{cdefghij}	9.00±0.45^{defghi}
	L	9.20±0.37^{defgh}	8.60±0.37^{bcd}	38.16±4.83^{ijkl}	13.80±0.80^{jklmn}	8.40±0.51^{fghi}
16OKS	U	9.60±0.24^{bcdefgh}	8.40±0.24^{bcd}	72.37±2.94^{defghi}	15.60±0.87^{bcdefghi}	9.20±0.49^{defghij}
	L	8.20±0.20^{hi}	5.00±0.20^{i}	34.21±4.83^{kl}	13.20±0.73^{jklmn}	10.80±0.37^{cdefgh}
17OMP	U	10.40±0.24^{abcde}	8.80±0.24^{bc}	98.68±11.39^{bcd}	16.60±1.63^{bcdefghi}	11.80±0.66^{cd}
	L	8.80±0.37^{fgh}	5.20±0.37^{i}	36.84±4.46^{jkl}	13.20±0.97^{jklmn}	8.60±0.60^{fghi}
180FF	U	10.40±0.40^{abcdef}	9.20±0.40^{b}	117.10±6.38^{abc}	17.20±1.20^{abcdef}	11.40±0.75^{cde}
	L	9.00±0.32^{efgh}	5.40±0.32^{hi}	31.58±2.46^{l}	12.60±0.75^{jklmn}	8.40±0.40^{fghi}
19EIY	U	9.60±0.24^{bcdefgh}	9.40±0.24^{b}	115.79±7.95^{abc}	17.40±0.51^{abcd}	11.40±0.51^{cde}
	L	8.80±0.37^{fgh}	6.20±0.37^{fghi}	31.58±2.46^{l}	13.20±0.97^{jklmn}	8.00±0.32^{hi}
20AJS	U	9.80±0.58^{abcdefg}	9.40±0.58^{b}	98.69±9.76^{bcd}	18.00±0.55^{abcd}	11.80±1.11^{cd}
	L	8.40±1.03^{gh}	7.20±1.03^{cdefg}	34.21±3.83^{kl}	12.80±0.80^{jklmn}	8.40±0.68^{fghi}

Mean values, standard error and different letters along columns depicting significant difference at 0.05 level using ANOVA test. Acc. Cod. No. = Accession Code Number, STLT = Stomata length, STWT = Stomatal width,

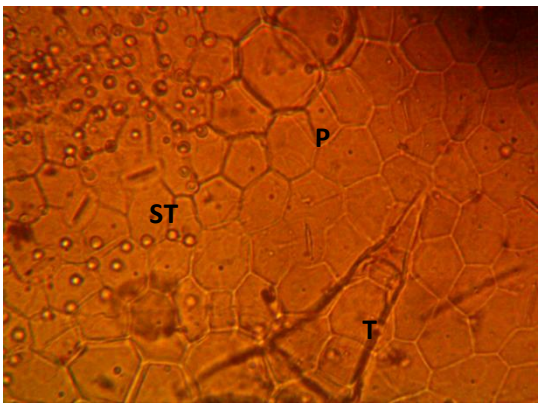
STD= Stomatal Density, ECWT = Epidermal cell width, ECLT = Epidermal cell length, U = Upper leaf surface, L = Lower leaf surface.

Table 5: Leaf Anatomical Features of the 20 accessions of two Luffa Species

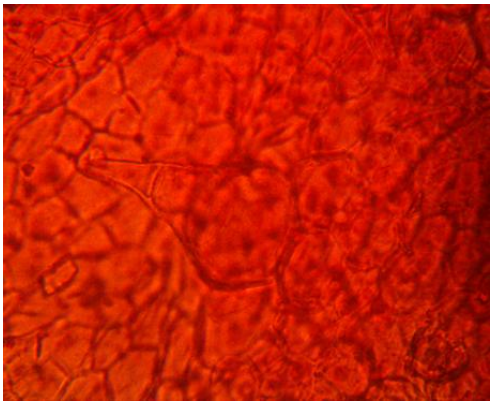
Acc. Cod. No	Surface	ECD	STSZ(μm ^{2})	STID(%)	ECS	Trichomes
01OGD	U	426.31±10.69^{cde}	72.09±4.69^{ab}	18.83±1.31^{abcde}	Polygonal	Present
	L	572.37±5.89^{a}	36.91±2.94^{ijklm}	7.24±0.84^{jkl}	Polygonal	Present
02UIL	U	436.84±11.32^{bcde}	51.35±6.89^{defghi}	16.63±0.8^{bcdefg}	Polygonal	Present
	L	552.63±25.05^{a}	36.75±3.28^{ijklm}	3.90±0.47^{j}	Irregular	Present
03AGB	U	438.16±29.17^{bcde}	33.92±2.82^{lm}	13.87±0.79^{fghi}	Polygonal	Present
	L	576.32±10.32^{a}	49.31±3.60^{efghijk}	7.56±0.95^{jkl}	Irregular	Present
04ADW	U	482.89±17.85^{bcd}	56.54±7.23^{cdefgh}	17.45±0.81^{abcdefg}	Polygonal	Present
	L	584.21±5.66^{a}	33.61±2.96^{lm}	5.12±0.37^{kl}	Irregular	Present
05SHK	U	547.37±13.71^{a}	47.74±4.14^{fghijkl}	20.02±0.79^{abc}	Polygonal	Present
	L	601.32±13.26^{a}	80.41±6.64^{a}	11.70±0.65^{hij}	Irregular	Present
06APL	U	436.84±11.32^{bcde}	50.26±6.26^{efghij}	16.63±0.80^{bcdefg}	Polygonal	Present
	L	568.42±21.48^{a}	35.81±1.52^{jklm}	9.99±6.38^{ijk}	Irregular	Present
07OKF	U	485.53±7.02^{bc}	61.72±7.80^{bcdef}	15.15±1.06^{defgh}	Polygonal	Present
	L	567.11±13.39^{a}	33.61±3.50^{lm}	8.11±0.70^{jkl}	Polygonal	Present
08ARP	U	460.53±8.58^{bcd}	64.70±5.33^{bcd}	14.30±2.25^{efghi}	Polygonal	Present
	L	561.84±19.25^{a}	44.45±5.61^{hijklm}	4.25±0.60^{l}	Polygonal	Present
09ALG	U	440.79±12.82^{bcde}	72.24±4.58^{ab}	15.82±0.87^{cdefgh}	Polygonal	Present
	L	569.74±11.51^{a}	50.57±4.02^{defghij}	3.78±0.27^{l}	Irregular	Present
10OKL	U	432.89±20.00^{bcde}	46.64±3.88^{ghijklm}	17.61±1.69^{abcdefg}	Polygonal	Present
	L	564.48±12.02^{a}	36.28±1.37^{klm}	4.89±0.32^{l}	Irregular	Present
11SNG	U	436.84±31.52^{bcde}	60.15±4.23^{abcdefg}	21.63±0.93^{a}	Polygonal	Present

	L	543.42±28.80^{a}	40.83±1.31^{ijklm}	5.33±0.67^{kl}	Polygonal	Present
12KSU	U	463.16±25.45^{bcd}	70.51±4.42^{abc}	17.90±1.78^{abcdef}	Polygonal	Present
	L	565.79±10.81^{a}	36.59±2.89^{ijklm}	4.24±0.65^{l}	Irregular	Present
13OLJ	U	384.21±20.13^{e}	81.67±6.38^{a}	19.48±2.29^{abcd}	Polygonal	Present
	L	553.95±11.09^{a}	37.54±5.61^{ijklm}	6.99±0.72^{kl}	Polygonal	Present
14OKY	U	436.84±14.80^{bcde}	34.39±2.66lm	14.21±0.30^{efghi}	Polygonal	Absent
	L	560.53±7.62a	34.24±3.52^{klm}	5.76±0.84^{kl}	Polygonal	Present
15OFG	U	465.79±27.55^{bcd}	47.43±3.17^{fghijkl}	12.95±0.96^{ghi}	Polygonal	Absent
	L	486.84±30.65^{b}	62.19±3.31^{bcde}	7.26±0.73^{jkl}	Irregular	Present
16OKS	U	436.84±14.80^{bcde}	63.45±3.16^{bcde}	14.21±0.30^{efghi}	Polygonal	Present
	L	560.53±7.62^{a}	32.04±1.54^{m}	5.76±0.84^{kl}	Irregular	Present
17OMP	U	436.84±28.27^{de}	71.93±3.72^{ab}	18.55±2.15^{abcdef}	Polygonal	Present
	L	565.79±12.48^{a}	35.96±3.22^{jklm}	6.10±0.67^{kl}	Irregular	Present
180FF	U	425.00±10.73^{bcde}	74.60±3.35^{ab}	21.62±1.16^{a}	Polygonal	Present
	L	567.11±9.63^{a}	38.01±1.33^{ijklm}	5.27±0.38^{kl}	Polygonal	Present
19EIY	U	438.16±20.87^{bcde}	70.83±3.43^{ab}	20.91±1.61^{ab}	Polygonal	Present
	L	563.16±10.73^{a}	43.35±5.72^{hijklm}	5.32±0.43^{kl}	Irregular	Present
20AJS	U	423.68±10.11^{de}	71.61±2.82^{ab}	18.79±1.51^{abcde}	Polygonal	Present
	L	569.74±12.76^{a}	46.96±5.74^{ghijklm}	5.71±0.72^{kl}	Polygonal	Present

Mean values, standard error and different letters along columns depicting significant difference at 0.05 level using ANOVA test. Acc. Cod. No. = Accession Code Number, ECD = Epidermal cell density, STSZ = Stomatal size, STID = Stomatal index, ECS = Epidermal cell shape, U = Upper leaf surface, L = Lower leaf surface.

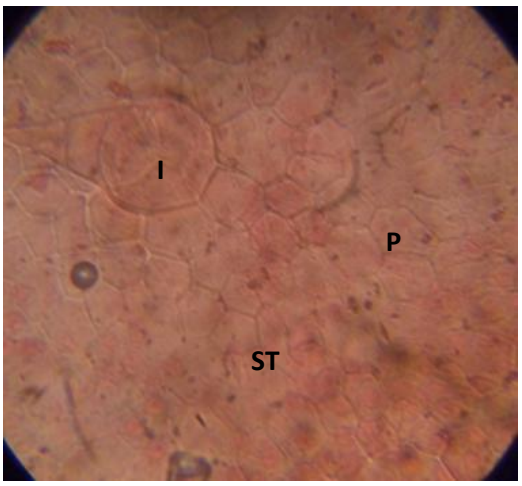


A



B

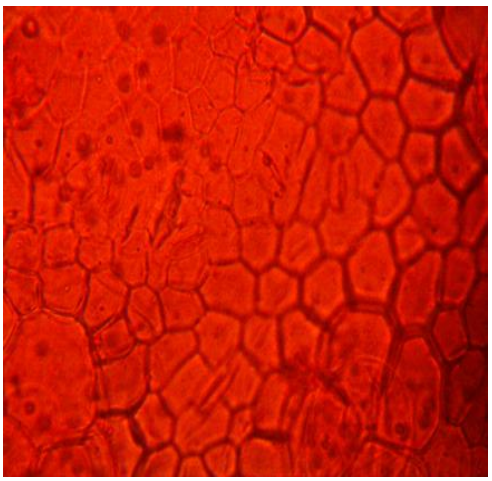
Plate 1:Photomicrographs of the *Luffa cylindrica* (A: Abaxial surface with l; B: Adaxial surface. ST: Staurocytic stomata; T: Trichome; P: Polygonal epidermal cell; I: Irregular epidermal cell)



A

ST

I



B

Plate 2:Photomicrographs of the *Luffa acutangula* (A: Abaxial surface with l; B: Adaxial surface. ST: Staurocytic stomata; T: Trichome; P: Polygonal epidermal cell; I: Irregular epidermal cell)

Fiber Mechanical Properties

The mechanical analysis of fiber revealed a significant difference ($p < 0.05$) in the mechanical properties of the fibers of the two *Luffa* species. Tensile stress ranged from 13.66 to 17.82 N/mm^2, tensile strain ranged from 0.05 to 0.09, percentage elongation ranges from 4.49% tom9.06%, tensile modulus ranged from 187.08 to 397.26 N/mm^2 (Table 6), flexural strength ranged from 45.65 to 8.82 N/mm^2, Impact energy ranged from 0.76 to 1.29J while hardness ranged from 91.01 to 96.71Hv (Table 7). *Luffa cylindrica* accessions demonstrates superior mechanical properties, particularly in tensile strength

(15–19 N/mm²), modulus, flexural strength (35–58 N/mm²), and hardness (up to 58 Hv), making it more suitable for applications requiring rigidity and strength. However, *Luffa acutangula*'s higher impact energy and elongation suggest it may be preferable for applications where flexibility and impact resistance are desired

Table 6: Mechanical Properties of Fires of the 20 Accessions of Luffa Species

Acc. No.	TStr (N/mm^2)	T Strain	% Elong	T Mod (N/mm^2)
01OGD	17.72±0.05^{a}	0.06 ±0.00^{cde}	6.64 ±0.17^{ef}	279.56±0.69^{e}
02UIL	17.82±0.09^{a}	0.08 ±0.01^{ab}	7.63 ±0.10^{c}	238.36±1.32^{ij}
03AGB	17.51±0.24^{a}	0.09 ±0.00^{a}	9.06 ±0.07^{a}	187.08±1.08^{p}
04ADW	17.70±0.09^{a}	0.07 ±0.00^{abcd}	6.97 ±0.17^{def}	261.52±0.62^{g}
05SHK	13.66±0.31f	0.06 ±0.00^{e}	4.49 ±0.27^{j}	307.26±3.16^{b}
06APL	14.36±0.29^{e}	0.05 ±0.00^{e}	4.89 ±0.02^{ij}	287.05±0.04^{c}
07OKF	16.85±0.11^{c}	0.06 ±0.00^{cde}	5.99 ±0.03^{gh}	282.40±0.73^{d}
08ARP	17.53±0.17^{a}	0.09 ±0.00^{a}	8.46 ±0.13^{b}	206.44±0.26^{n}
09ALG	14.73±0.12^{e}	0.07 ±0.00^{abcd}	7.23 ±0.21^{cd}	210.16±0.17^{m}
10OKL	14.66±0.16^{e}	0.07 ±0.00^{abcd}	6.28 ±0.14^{fg}	240.91±0.29^{i}
11SNG	16.61±0.19^{c}	0.07 ±0.00^{abcd}	6.60 ±0.28^{ef}	237.26±0.11^{j}
12KSU	14.67±0.15^{e}	0.07 ±0.01^{bcd}	5.68 ±0.14^{h}	273.81±0.37^{f}
13OLJ	15.31±0.16^{d}	0.07 ±0.01^{bcd}	5.93 ±0.04^{gh}	251.03±0.56^{h}
14OKY	13.66±0.17^{f}	0.07 ±0.00^{abcd}	6.68 ±0.13^{ef}	207.25±0.16^{n}
15OFG	14.68±0.20^{e}	0.08 ±0.00^{ab}	7.61 ±0.21^{c}	195.14±0.08^{o}
16OKS	16.63±0.06^{c}	0.07 ±0.00^{abcd}	6.80 ±0.08^{def}	239.22±0.20^{ij}
17OMP	17.42±0.24^{ab}	0.08 ±0.00^{abc}	8.31 ±0.18^{b}	212.45±0.28^{lm}
180FF	16.92±0.05^{bc}	0.06 ±0.01^{de}	5.10 ±0.34^{i}	338.03±0.74a
19EIY	16.50±0.18^{c}	0.08 ±0.00^{abc}	7.68 ±0.09^{c}	223.73±0.28^{k}
20AJS	12.69±0.34^{g}	0.06 ±0.00^{cde}	5.68 ±0.03^{h}	213.55±0.29^{l}

Table 7: Mechanical properties of fibres of the 20 accessions of *Luffa* species

Acc. No.	FL Strt (N/mm^2)	Impact (J)	Hardness (Hv)
01OGD	58.81 ±0.42^{a}	0.92±0.04^{hi}	96.44 ±0.51^{ab}
02UIL	57.48 ±0.48^{b}	0.78±0.01^{k}	93.70 ±0.12^{efgh}
03AGB	56.03 ±0.03^{cd}	0.87±0.01^{ij}	94.19 ±0.10^{defg}
04ADW	49.37 ±0.27^{h}	0.95±0.02^{gh}	94.67 ±2.34^{bcdef}
05SHK	49.47 ±0.25^{h}	1.06±0.02^{de}	96.06 ±0.02^{abc}
06APL	54.75 ±0.22^{fg}	1.08±0.01^{cde}	92.05 ±0.02^{hi}
07OKF	55.88±0.14^{cde}	0.88±0.02^{ij}	91.01 ±0.02^{i}
08ARP	58.42 ±0.24^{a}	0.79±0.00^{k}	94.91 ±0.12^{abcdef}
09ALG	57.47 ±0.04^{b}	0.84±0.01^{j}	96.01 ±0.01^{abc}
10OKL	56.54 ±0.26^{c}	0.91±0.00^{hi}	96.01 ±0.01^{abc}
11SNG	56.20 ±0.19^{c}	0.76±0.00^{k}	96.05 ±0.05^{abc}
12KSU	54.80 ±0.13^{fg}	0.98±0.00^{fg}	95.70 ±0.13^{abcd}
13OLJ	55.37 ±0.37^{def}	0.89±0.00^{ij}	94.43 ±0.06^{cdef}
14OKY	49.48 ±0.25^{h}	1.29±0.01^{a}	91.45 ±0.12^{i}
15OFG	45.65 ±0.21^{i}	1.13±0.04^{bc}	93.17 ±0.06^{fgh}
16OKS	55.30±0.18^{defg}	0.96±0.02^{gh}	95.14 ±0.06^{abcde}
17OMP	55.13 ±0.06^{efg}	1.07±0.01^{de}	95.15 ±0.05^{abcde}
180FF	56.56 ±0.08^{c}	1.17±0.01^{b}	96.71 ±0.10^{a}
19EIY	56.55 ±0.29^{c}	1.10±0.01^{cd}	94.57 ±0.08^{cdef}
20AJS	54.58 ±0.12^{g}	1.03±0.01^{ef}	92.56 ±0.05^{ghi}

Mean values, standard error and different letters columns depicting significant difference at P< 0.05 level using ANOVA test.Acc. No. = Accession Code Number, TStre = Tensile stress, Tstrain = Tensile strain, %Elong = Percentage elongation, Tmod = Tensile Modulus, Fl strt = Flexural Strength, Impact = Impact energy (strength), Hardness = Hardness, ± Standard error.

Discussion

The study provided analysis of the morpho-anatomical characteristics and fiber quality of *L. cylindrica* and *L. acutangula*. Results observed variation in stem girth, leaf length and leaf width showing the inherent variability with the genus *Luffa*. This is influenced potentially by genetic and environmental variability and adaptation within the study region (Zalapa *et al*., 2006). The distinct variability in qualitative traits supported the established taxonomic differentiation between the two species (Manikandaselvi *et al*., 2016). Anatomical findings showed that Luffa species are amphistomatic, a common feature in dicotyledonous plant which facilitates gaseous exchange (Khan *et al*. 2017). Differential distribution of trichomes present in both upper and lower epidermal surface of *L. cylindrica* and absent in the lower epidermal layer of *L. acutangula* could have implications for transpiration regulation and defense against herbivory (Viera *et al*., 2019). Morphological and anatomical traits confirmed that *L. cylindrica* possesses a broader range of adaptive features and fibre quality. The presence of trichomes on both surfaces and higher stomatal index suggested better adaptation to environmental conditions.

The significantly higher tensile strength observed in *L. cylindrica* suggests greater suitability for structural and reinforcement applications. This finding corroborates earlier reports by Boynard and D'Almeida (1999) and Tanobe et al. (2005), who reported favourable mechanical properties in *Luffa cylindrica* fibres.. Tensile strength is a crucial significant mechanical character that determines the suitability of fibers for reinforcement in composite materials and other structural application (Yan *et al*., 2012; Kumar *et al*., 2015). These findings further supported previous report of favourable mechanical properties of L. cylindrica fibres (Zampheri *et al*. 2016). The difference in fiber strength could be attributed to differences in the chemical composition such as cellulose content, microfibrillar angle and structural arrangements of fibers in the two species (Mohanty *et al*., 2000). The mechanical and chemical superiority of its fibers aligns with previous reports (Boynard & D'Almeida, 1999; Tanobe *et al*., 2005) while *L. acutangula* is useful, its softer, more elastic fibres are less suitable for load-bearing composites.

Conclusion

This study provided a comprehensive evaluation of the morphological, anatomical, and fibre-quality characteristics of Luffa cylindrica and Luffa acutangula accessions cultivated in Kwara State, Nigeria. Significant interspecific differences were observed in morphological traits, epidermal features, and mechanical properties of the fibres. Luffa cylindrica exhibited superior vegetative growth, greater tensile strength, higher tensile modulus, improved flexural strength, and greater hardness than L. acutangula. These characteristics indicated its greater potential for industrial applications, particularly in the production of bio-composites and other environmentally sustainable materials.

The anatomical features identified, including stomatal characteristics and trichome distribution, provided useful taxonomic markers for distinguishing the two species. The study, therefore, contributed valuable information for taxonomy, breeding programmes, conservation efforts, and industrial utilisation of Luffa species in Nigeria.

Future studies should integrate molecular characterisation techniques with morphological and anatomical data to strengthen species delimitation. Further investigations on fibre chemistry, durability, and large-scale industrial applications are also recommended.

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CHAPTER SIXTEEN

Global Antimicrobial Resistance Surveillance: Advocating for a sustainable future

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Abstract

Antimicrobial resistance (AMR) causes treatment failures, prolonged sickness, and higher mortality. The integration of a "One Health Approach" in the human, animal, and environmental health sectors through multisectoral collaboration is vital for AMR surveillance. This review highlighted the current AMR surveillance efforts. Tracking the trends of resistant infections across populations and regions is made easier by advocating sustainable educational initiatives of AMR surveillance. Some ongoing surveillance efforts include "the World AMR Awareness Week (WAAW), the Global Antimicrobial Resistance and Use Surveillance System (GLASS), the ResistanceMap, and the UK's Fleming Fund". The WHO's GLASS offers a unified framework for countries to track the progress of existing and emerging national surveillance systems.

Keywords: Global Antimicrobial, Resistance Surveillance, Sustainable, Future

Introduction

Tenmillion deaths worldwide would result from antibiotic resistance by 2050 if the current trend of inappropriate and excessive antibiotic use continues (Pulingam *et al.,* 2022). Antimicrobial resistance, a notable health concern that occurs when microbes (bacteria, viruses, fungi, and parasites) evolve mechanisms that protect them from the effects of antimicrobials (including antibiotics, antifungals, antivirals, and antiparasitics), enabling them to thrive (Ahmed *et al.,* 2024). These resistant microorganisms can spread and infect people, plants, and animals. "The overuse and abuse of antibiotics in various industries have led to the evolution of resistant bacteria, which is a primary

cause of antimicrobial resistance (AMR), a serious global health concern" (Ahmed *et al.,* 2024).

Surveillance of antimicrobial resistance is a fundamental action to inform efforts to handle the spread of AMR through the generation of evidence for local, national, and global guidance and action plans (Lim *et al*., 2021). "AMR surveillance involves the collection, validation, interpretation, and reporting of susceptibility data" (Lim *et al*., 2021).

The introduction of the "One Health Approach" calls for a worldwide cooperative effort involving several disciplines, including the "World Organisation of Animal Health (WOAH, formally OIE) and the Food and Agriculture Organisation of the United Nations (FAO), to guarantee that each agency operates within its area of expertise and with other agencies to minimise the possible effects of AMR" (Tang *et al*., 2023).

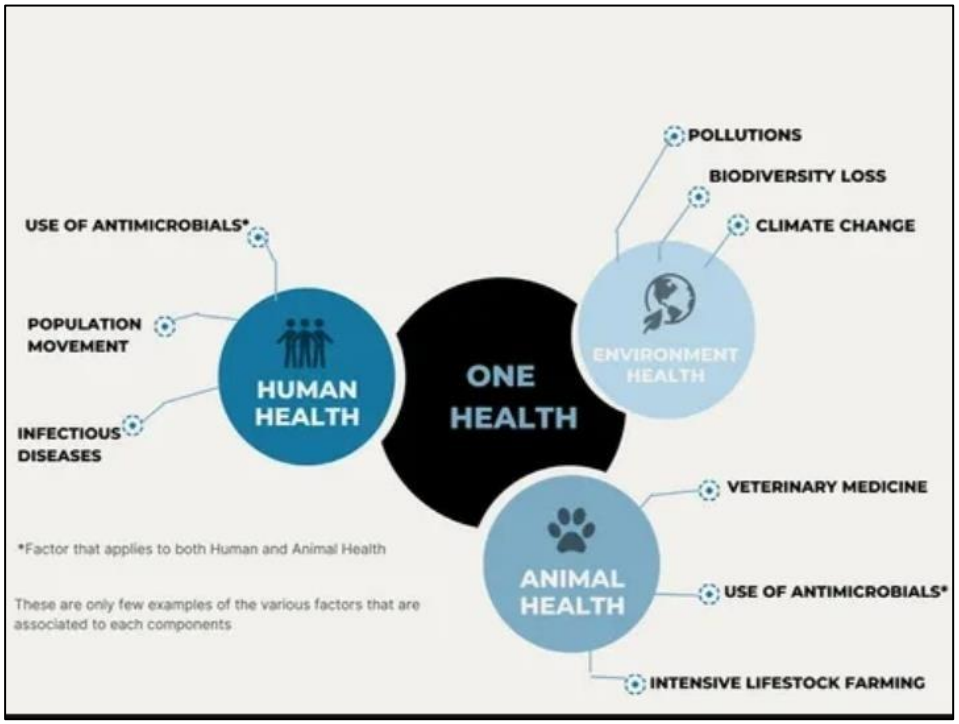


Figure 1: The concept of the One Health Approach (Tang *et al*., 2023)

Current AMR Surveillance Efforts

In 2015, the World Health Organisation (WHO) introduced the Global Action Plan on Antimicrobial Resistance (GAP AMR) to combat the growing global danger of antimicrobial resistance (AMR) (Khouja *et al*., 2022)

- Improve awareness and understanding (WHO, 2020).
- Strengthen knowledge through surveillance & research (WHO, 2020).
- Reduce the incidence of infection (WHO, 2020).
- Optimize the use of antimicrobial medicines (WHO, 2020).
- Ensure sustainable investment (WHO, 2020).

World AMR Awareness Week (WAAW)

The World AMR Awareness Week (WAAW), formerly called the World Antimicrobial Awareness Week, is celebrated from the 18th to the 24th of November every year to improve awareness and understanding of antimicrobial resistance (Sharma *et al*., 2024). In the year 2024, the World Antimicrobial Awareness Week was themed “Educate. Advocate. Act now.”

The theme aimed to raise awareness and understanding of antimicrobial resistance (AMR) and promote best practices among "One Health" stakeholders to reduce the emergence and spread of drug-resistant infections (Sharma *et al*., 2024).

The Global Antimicrobial Resistance and Use Surveillance System (GLASS)

The World Health Organisation (WHO) launched the Global Antimicrobial Resistance and Use Surveillance System (GLASS) after creating the Global Action Plan for managing AMR (GAP-AMR) to continuously fill in the knowledge gaps and accomplish the objectives "strengthen knowledge through surveillance and research" of the GAP-AMR program (WHO, 2021). On the 22nd of October 2015, the World Health Organisation (WHO) launched the Global Antimicrobial Resistance and Use Surveillance System (GLASS) to standardise the surveillance of antimicrobial resistance (AMR) (WHO, 2020). GLASS offers a standardised method for data collection, analysis, interpretation, and exchange among nations (WHO, 2020).

The various types of AMR-related surveillance activities led by GLASS are

grouped into a series of technical modules (WHO, 2020). These modules comprise surveillance activities built on routinely available data (for example, patient samples collected for clinical purposes or national sales of antimicrobials) and focused activities targeted at generating information for specific purposes, based on the needs of countries and regions (WHO, 2020). GLASS is also engaged in the design and implementation of surveys and studies aimed at helping countries to achieve a better quality and representativeness of their data (WHO, 2020). Furthermore, GLASS provides support, including evidence-based guidelines and technical documents, to assist countries and regions in building capacity and take appropriate and timely corrective actions (WHO, 2020).

The GLASS IT platform (https://extranet.who.int/glass/portal/), launched by the World Health Organization (WHO) in 2016, was designed for global data on antimicrobial resistance (AMR), Antimicrobial consumption (AMC), and Antimicrobial use (AMU), and also functions as a central platform for data sharing (WHO, 2020). Most of the IT components of GLASS's technical modules are hosted on this platform. Since its initial release, new analysis and export features have been added, improving its capabilities. Countries, territories, and regions can generate and export reports with graphical data representations and verify their accuracy using multiple metrics through data visualization (WHO, 2020). The user interface has been redesigned to offer a more straightforward, user-friendly, and intuitive experience (WHO, 2020).

ResistanceMap

In 2010, the ResistanceMap was created to help guide policies tackling antimicrobial resistance (AMR) by the Centre for Disease Dynamics, Economics & Policy (now One Health Trust) (Kapoor, 2021). It is an interactive global network that monitors changes in antibiotic use and resistance, offering vital information for public health initiatives (Kapoor, 2021). Antimicrobial resistance (AMR) and antibiotic use patterns in nations worldwide, including some "low- and middle-income countries (LMICs)", can be interactively explored with ResistanceMap (a web-based set of data visualization tools) (Kapoor, 2021).

UK's Fleming Fund

The Fleming Fund, supported by the UK Department of Health through its UK Aid, overseas development assistance programme, is one of the most

important multinational efforts aimed at enhancing AMR and AMC surveillance in "low- and middle-income countries (LMICs)" (Frost *et al*., 2021). The Fund takes a One Health approach and promotes surveillance activities at institutional, national, and regional levels through a £265 million investment (Frost *et al*., 2021). The Fleming Fund's initiatives complement and support existing AMR strategies, including national action plans, antimicrobial stewardship programmes, the development of empirical treatment guidelines, and regional frameworks such as the African Union's AMR control framework (Frost *et al*., 2021). Through various national and regional grants and programmes, the UK's Fleming Fund intends to establish sustainable AMR surveillance systems in over 30 countries across both Asia and Africa, while also encouraging cooperation among governments, the private sector, NGOs, academia, and the pharmaceutical and research communities (Frost *et al*., 2021).

Challenges Faced by Antimicrobial Resistance Surveillance Systems in the World

Data gathering and aggregation are extremely difficult tasks since information systems are frequently paper-based (Frost *et al*., 2021).

The funding of AMR control activities is "sector-specific" and mainly focused on human health. AMR control initiatives in non-human health domains are either "underfunded or undeveloped" in several LMICs (Frost *et al*., 2021).

The challenges are severe in low-income environments due to inadequate communications and laboratory infrastructures, limited resources, a shortage of skilled and qualified personnel, and a variety of behavioural and socioeconomic factors that contribute to resistance (Iskandar *et al*., 2021). "The quality and dependability of pathogen identification and antimicrobial susceptibility testing might be impacted by inadequate laboratory infrastructure" (Iskandar *et al*., 2021).

The underestimated impact of AMR is due to the weak connections between the environmental, animal, and human health sectors. This could be the result of conflicting political and economic objectives (Frost *et al*., 2021).

Due to inadequate continent-wide AMR surveillance data, gaining a complete understanding of the extent and impact of antimicrobial resistance (AMR) in

Africa remains a significant challenge. Although country data are available, they are not regularly gathered, disseminated, or acknowledged by national bodies, which restricts their ability to impact national policies (Okolie *et al*., 2023).

Strategies for Sustainable Antimicrobial Resistance Surveillance Systems

A key factor in determining the long-term success of AMR monitoring systems is ensuring financial sustainability. Finding outside finance through trusts and other funds has been the main strategy used in the literature to get beyond financial obstacles (Do *et al*., 2023).

Legal underpinnings (legal principles, laws, and precedents) for surveillance must be investigated to enhance surveillance systems and promote stakeholder cooperation where obstacles might exist (Do *et al*., 2023).

Accelerated implementation of one health national action plans must be at the heart of the global response to antimicrobial resistance (WHO, 2020). The establishment of good monitoring systems necessitates strong political will, capacity building, standardisation of procedures, tight coordination between all stakeholders, and a One Health approach (Frost *et al*., 2021).

Conclusion

Antimicrobial resistance causes treatment failures, longer sickness, and higher death, making it one of the WHO's top 10 worldwide public health challenges. It has a substantial financial impact on economies and healthcare systems. An integrated strategy is essential to address the escalating issue of antimicrobial resistance (AMR). This involves optimising antibiotic usage in healthcare environments, enhancing infection prevention and control measures, fostering innovation in antimicrobial drug discovery through dedicated research efforts, and educating both healthcare providers and the public on the critical importance of responsible antimicrobial stewardship. Working together to address this global problem can effectively slow the spread of antimicrobial resistance and maintain the effectiveness of the antimicrobial chemotherapies currently in use. Global cooperation, more funding, and ongoing political commitment are needed to combat AMR. In the battle against AMR, surveillance is essential since it allows for progress tracking and focused treatments.

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CHAPTER SEVENTEEN

Access to and Utilisation of Agricultural Extension Services Among Small-Scale Farmers in Asa Local Government Area, Kwara State, Nigeria: Challenges and Policy Implications

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Abstract

Small-scale farmers in Nigeria rely on agriculture for their livelihoods but face significant barriers in accessing effective extension services. This study examined these challenges using a mixed-methods approach involving qualitative and quantitative tools. Findings revealed that while extension services exist, they are underutilised. Radio, farmer cooperatives, and local networks were the primary information sources. Core services included advisory support and market information, while training programmes and workshops were least accessed. Key benefits noted were improved market access, productivity, and knowledge transfer. However, challenges such as inadequate funding, limited training, poor infrastructure, and restricted access to technology hindered effective utilisation. The study recommended increased funding, tailored training, infrastructural improvements, and stronger cooperatives. These strategies are essential for empowering small-scale farmers and promoting sustainable agricultural development in Nigeria.

Keywords: Agricultural Extension, Information Access, Small-scale farmers, Capacity building.

Introduction

The agricultural landscape of Nigeria is not only reliant on fertile soils but also shaped by a diverse community of farmers with varying needs and challenges (Ojo & Aliyu, 2022). Small-scale agriculture is vital for food security, employment, and the economic stability of the country (Adamu et al., 2021). It contributes to rural development, generates income, and plays a central role in household sustenance. Additionally, sustainable practices in

smallholder farming build resilience to climate variability and preserve cultural heritage (Adejuwon, 2020).

Despite its importance, small-scale farming is characterised by inadequate infrastructure, limited access to modern technology, and insufficient knowledge dissemination. These factors hinder productivity and competitiveness. Agricultural extension services are critical for bridging this gap, offering farmers relevant information, training, and technical support (Brown, 2021).

Given Nigeria's vast geographical and cultural diversity, a one-size-fits-all approach to extension service delivery is ineffective. Tailored services that reflect local realities and resource limitations are essential. Farmers face multiple barriers including poor road networks, limited funding, and constrained access to up-to-date agricultural practices (Johnson & Williams, 2019). In the era of digital agriculture and climate change, timely and inclusive extension services are more important than ever.

Agricultural extension acts as a bridge between innovation and practice, enabling the diffusion of sustainable techniques, access to markets, and adaptation to environmental change. However, the effectiveness of these services in Nigeria is often compromised by systemic issues such as underfunding, weak institutional support, and the absence of farmer-centred programming (Smith & Johnson, 2020).

This study explored these dynamics in Asa Local Government Area of Kwara State. The aim of the study was to provide a nuanced understanding of the extension services landscape, focusing on the experiences of small-scale farmers in a local government area of Nigeria. These farmers often operate within familial systems, relying on informal knowledge transfer and limited external support. Their resilience, though remarkable, is threatened by the changing demands of modern agriculture.

This study r sought to identify not only the challenges but also practical and locally appropriate solutions. The study investigated the sources of agricultural information, the crops cultivated, available extension services, perceived benefits, and the key constraints affecting extension service access. By understanding these dimensions, the research contributed to policy discussions and intervention strategies for strengthening extension systems in rural Nigeria.

Literature Review

Historical Development of Agricultural Extension Services

The historical development of agricultural extension services reflects a trajectory shaped by evolving agrarian practices, national policy shifts, and global development paradigms. In Nigeria, extension services began to formalise during the mid-20th century under government-led initiatives aimed at increasing agricultural productivity and tackling food insecurity. These services initially focused on top-down knowledge transfer from research institutions to farmers (Kumar et al., 2021).

The Green Revolution era marked a turning point in agricultural extension by introducing high-yield varieties, chemical inputs, and mechanisation. However, this approach often marginalised small-scale farmers due to a lack of adaptation to local conditions (Brown & Taylor, 2022). In response, more participatory and decentralised models have emerged in recent years, emphasising farmer involvement, gender inclusiveness, and sustainability.

Agricultural Extension Services in Contemporary Practice

Modern agricultural extension systems aim to bridge the gap between research outputs and farming practices by offering farmers information, training, and tools for improved decision-making (Singh & Jain, 2020). These services are delivered through a variety of methods including on-farm demonstrations, workshops, mobile platforms, and community outreach programmes (Tilak et al., 2020).

A shift toward demand-driven and decentralised extension models has occurred globally, with Nigeria following suit through programmes like the Agricultural Transformation Agenda Support Programme (ATASP) and the National Agricultural Extension and Research Liaison Services (NAERLS). Nonetheless, the capacity of these systems remains constrained by poor funding, inadequate staffing, and limited reach to rural communities (Ogunleye & Alabi, 2021).

Access to Agricultural Information

Access to agricultural information is crucial for empowering farmers with the knowledge needed to optimise yields, improve resilience, and engage competitively in markets. In Nigeria, radio remains a dominant source of

information for smallholder farmers, followed by cooperatives and informal networks (Ogungbade, 2019). Increasingly, mobile technologies and digital platforms are being adopted for real-time dissemination of market prices, weather forecasts, and pest control updates (Okorie & Adegbite, 2022).

Access to quality information has been shown to improve agricultural productivity and income (Adepoju et al., 2023). However, barriers such as language differences, digital illiteracy, and infrastructure deficits continue to hinder information flow in remote areas.

Challenges Facing Small-Scale Farmers in Nigeria

Small-scale farmers encounter numerous structural and systemic challenges, including limited access to inputs, credit facilities, modern technologies, and markets (Smith et al., 2019). Climate variability further compounds these issues through erratic rainfall, rising temperatures, and increased pest incidence (Jones & Brown, 2021).

Moreover, the fragmentation of agricultural extension services among multiple actors—government, NGOs, and private firms—often leads to duplication and gaps in service delivery (Ibrahim & Yakubu, 2021). A lack of tailored training programmes, coupled with weak linkages between research and extension, undermines the effectiveness of these services.

To improve outcomes, studies suggest that a more coordinated, well-funded, and farmer-centred approach is essential. Leveraging community-based networks and digital platforms can enhance information reach, while ongoing capacity-building efforts are necessary to equip extension agents with up-to-date knowledge (Eze & Nwachukwu, 2020).

Methodology

The study was conducted in Asa Local Government Area of Kwara State, Nigeria. Asa is predominantly agrarian with a high population of smallholder farmers engaged in crop production. A mixed-methods research design was employed to ensure comprehensive data collection, combining qualitative insights with quantitative analysis for triangulation and validation.

A two-stage sampling technique was adopted. In the first stage, three communities—Laduba, Budo Agun, and Ago Oja—were purposively selected based on their farming intensity and accessibility. In the second stage, a

simple random sampling technique was used to select respondents from each community. A total of 120 respondents were selected, representing approximately 40% of the farming population across the selected communities.

Data were collected using a structured questionnaire comprising both closed- and open-ended questions. The instrument was validated through expert review and piloted in a neighbouring local government area to ensure clarity and reliability. The questionnaire captured demographic information, sources of agricultural information, access to extension services, perceived benefits, and constraints.

Data were analysed using both descriptive and inferential statistics. Descriptive statistics such as frequencies, means, and percentages summarised the respondents' characteristics and responses. Inferential statistics, including regression analysis, were employed to determine the relationships between variables and to identify key factors influencing access to extension services.

Results and Discussion

Table 1: Distribution of Respondents Based on the Sources of Information Utilized by the Respondents

S/N	SOURCE OF INFORMATION	Frequency	Percentage
1	Agricultural extension services.	66	55.0
2	Farmer association and cooperatives.	87	72.5
3	Radio / Television.	93	77.5
4	Social media.	58	48.3
5	Local farmer network.	81	67.5
6	Newspaper.	39	32.5

Source: Field survey, 2024

Sources of Information Utilised by Respondents

Findings in Table 1 indicate that radio and television (77.5%) were the most widely used sources of agricultural information. This reflects the widespread accessibility and affordability of mass media. Farmer associations and cooperatives (72.5%) were also important, underscoring the social dynamics

of group-based knowledge sharing. Local farmer networks (67.5%) and extension services (55.0%) served as complementary sources. Although social media (48.3%) and newspapers (32.5%) were the least utilised, their growing relevance among digitally literate farmers suggests potential for future expansion. This supported Ogungbade (2019), who noted similar trends in Kwara State.

Types of Crops Cultivated

Table 2. Distribution of Respondents Based on the types of Crops Cultivated

TYPES OF CROPS CULTIVATED	Frequency	Percentage
Cassava	101	84.2
Maize	113	94.2
Potatoes	64	53.3
Rice	31	25.8
Beans (cowpea)	74	61.7
Yam	100	83.3
Vegetables	105	87.5
Plantain	57	47.5
Soya beans	43	35.8
Guinea corn	52	43.3

Source: Field survey, 2024

Table 2 reveals that maize (94.2%) was the most commonly cultivated crop, followed by vegetables (87.5%), cassava (84.2%), and yam (83.3%). These crops are staples in the region and contribute significantly to food security and household income. Beans (61.7%), potatoes (53.3%), and plantain (47.5%) were also fairly common. Crops like soybean, guinea corn, and rice were grown by less than half of the respondents. This pattern suggests a preference for crops with short gestation periods and high local demand, aligning with the findings of Abdulaleem et al. (2019).

Access to Agricultural Extension Services

Table 3. Distribution of Respondents Based on Use of Agricultural Extension Services

AGRICULTURAL EXTENSION SERVICES AVAILABLE	MOSTLY USED	OCCASIONALLY USED	RARELY USED	NOT USED	Mean	Rank
Farmer Cooperatives.	32 (26.7)	33 (27.5)	31 (25.8)	24 (20.0)	2.61	1st
Advisory services.	20 (17.5)	26 (21.7)	53 (44.2)	21 (16.7)	2.60	2nd
Market and value chain information.	23 (19.2)	39 (32.5)	37 (30.8)	21 (17.5)	2.53	3rd
Farm visits and Demonstrations.	20 (16.7)	37 (30.8)	14 (11.7)	49 (40.8)	2.23	4th
Non-Governmental Organizations.	19 (15.8)	29 (24.2)	15 (12.5)	57 (47.5)	2.08	5th
Awareness campaign.	13 (10.8)	31 (25.8)	22 (18.3)	54 (45.0)	2.02	6th
Agricultural agencies.	7(5.8)	29 (24.2)	31 (25.8)	52 (43.3)	1.95	7th
Financial supports.	12 (10.0)	24 (20.0)	11 (9.2)	73 (60.8)	1.79	8th
Training programs.	15 (12.5)	18 (15.0)	14 (11.7)	73 (60.8)	1.79	8th
Workshop.	7 (5.8)	14 (11.7)	22 (18.3)	77 (64.2)	1.59	10th

Source: Field survey, 2024

As presented in Table 3, farmer cooperatives (mean = 2.61) and advisory services (mean = 2.60) were the most frequently accessed forms of extension

support. These were followed by market and value chain information (2.53). Services such as farm visits, NGO support, and awareness campaigns were used less frequently, while training programmes and workshops were the least accessed (mean = 1.79 and 1.59 respectively). This indicates a gap in capacity-building initiatives, possibly due to poor outreach, resource constraints, or lack of farmer awareness. Enhancing training delivery could significantly improve knowledge uptake and innovation adoption.

Table 4: Distribution of Respondents Based on the Benefit of Agricultural Extension services

BENEFITS	SA	A	UD	D	SD	Mean	Rank
Access to market information and opportunities	38 (31.7)	28 (23.3)	2 (1.7)	26 (21.7)	26 (21.7)	3.22	1st
Access to farm demonstration and training programs.	39 (32.5)	32 (26.7)	0(0)	13(10.8)	36(30.0)	3.21	2nd
Enhance productivity and profitability	34 (28.3)	25 (20.8)	7 (5.8)	35 (29.2)	19 (15.8)	3.16	3rd
Provide valuable knowledge and guidance	34 (28.3)	29 (24.2)	2 (1.7)	31 (25.8)	24 (20.0)	3.15	4th
Improve communication and understanding	16 (13.3)	30 (25.0)	9 (7.5)	45 (37.5)	20 (16.7)	2.81	5th
Adoption of new technologies and practices.	29 (24.2)	28 (23.3)	3 (2.5)	8 (6.7)	52 (43.3)	2.78	6th
Proper infrastructure such as good roads and	12 (10)	35 (29.2)	8 (6.7)	43 (35.8)	22 (18.3)	2.76	7th

communication network							
Access to financial resources and government support programs.	20 (16.7)	29 (24.2)	2 (1.7)	7 (5.8)	62 (51.7)	2.48	8th

Source: Field survey, 2024

Table 4 highlights that farmers recognised access to market information (mean = 3.22) and training programmes (mean = 3.21) as the most beneficial aspects of extension services. Enhanced productivity (3.16), knowledge guidance (3.15), and communication improvement (2.81) also scored moderately. However, benefits related to technology adoption (2.78), infrastructure (2.76), and financial access (2.48) were rated lower, revealing structural limitations in service delivery. The findings support earlier claims by Adepoju et al. (2023) that farmers benefit most when extension services are aligned with market and training support.

Table 5: Distribution of Respondents Based on the Constraints in Accessing Agricultural Extension Services

CONSTRAINTS	SA	A	UD	D	SD	Mean	Rank
Inadequate funding and resources.	92 (76.7)	20 (16.7)	1 (0.8)	5 (4.2)	2 (1.7)	4.63	1st
Lack of training and education.	84 (70.0)	21 (17.5)	2 (1.7)	8 (6.7)	5 (4.2)	4.43	2nd
Limited access to technology and information resources.	71 (59.2)	34 (28.3)	2 (1.7)	11 (9.2)	2 (1.7)	4.34	3rd
Inadequate capacity building programs.	47 (39.2)	51 (42.5)	10 (8.3)	11 (9.2)	1 (0.8)	4.10	4th

Poor infrastructure and transportation difficulties.	31 (25.8)	73 (60.8)	5 (4.2)	7 (5.8)	4 (3.3)	4.00	5th
Lack of awareness about available agricultural extension services.	36 (30.0)	59 (49.2)	7 (5.8)	16 (13.3)	2 (1.7)	3.92	6th
Lack of access to market information and linkages.	39 (32.5)	44 (36.7)	9 (7.5)	20 (16.7)	8 (6.7)	3.72	7th
Language and cultural barriers	21 (17.5)	65 (54.2)	10 (8.3)	17 (14.2)	7 (5.8)	3.63	8th
Government policies and regulations.	34 (28.3)	27 (22.5)	8 (6.7)	7 (5.8)	44 (36.7)	3.00	9th

Source: Field survey, 2024

Table 5 shows that inadequate funding (mean = 4.63), lack of training (4.43), and limited access to technology (4.34) were the most critical constraints. Capacity-building gaps (4.10), poor infrastructure (4.00), and lack of awareness (3.92) were also significant. Challenges such as market access, language barriers, and government policy were considered less severe. These results echo Eze and Nwachukwu (2020), who argued for more coordinated investments in training, digital tools, and transport infrastructure to expand reach and impact of extension services.

Conclusion

This study has shown that although agricultural extension services were available in Asa Local Government Area of Kwara State, their utilisation among small-scale farmers remained limited. Farmers predominantly relied on radio, farmer cooperatives, and local networks to obtain agricultural information, while modern tools such as training workshops and digital platforms were under-utilised. The most cultivated crops included maize, vegetables, cassava, and yamstaples that reflect the nutritional and economic preferences of the region.

While farmers acknowledged several benefits from extension services, including improved market access and productivity, the study also uncovered considerable constraints. Inadequate funding, limited access to training, poor infrastructure, and insufficient technology remain significant challenges.

The findings underlined the need for robust policy frameworks and sustainable investment in extension services. Bridging the information and capacity gaps would require greater collaboration between government agencies, NGOs, and community-based organisations. Strengthening these systems is crucial for fostering innovation, improving agricultural productivity, and enhancing the livelihoods of small-scale farmers.

Recommendations

1. **Increase Government and Stakeholder Funding**: Improved financial support is critical for enhancing the quality and reach of extension services.
2. **Expand Training and Capacity Building**: Organise regular training sessions tailored to the specific needs of smallholder farmers.
3. **Leverage Cooperative Networks**: Strengthen farmer associations as platforms for information dissemination and resource pooling.
4. **Integrate Digital Tools**: Encourage the use of mobile-based and media-based information systems to expand access to agricultural advice and market data.
5. **Improve Infrastructure**: Investment in rural road networks and communication systems will facilitate easier access to extension services.
6. **Enhance Awareness and Outreach**: Intensify sensitisation efforts to inform farmers of the available extension resources and their benefits

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CHAPTER EIGHTEEN

Leveraging Earth Science Education in Environmental Sustainability in Africa

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Abstract

Environmental sustainability involves integrating sustainable practices and principles into environmental management. The knowledge of earth sciences is useful in the management of climate change, natural resources, including water, mineral and fossil fuels. The application of various aspects of earth sciences is pivotal in ecosystem and biodiversity conservation, soil health, sustainable agriculture and mitigation of natural disasters. In recent times, interdisciplinary approaches have been greatly utilised in understanding the exploration and exploitation of natural resources and their effect on human life. The aim of this study was to understand natural systems and make informed decisions that contribute to the health of humanity.

Keywords: Environmental sustainability, Earth sciences, Soil health, Mitigation.

Introduction

Africa is facing significant environmental sustainability challenges, including climate change (IPCC, 2020), deforestation (FAO, 2020), desertification (UNCCD, 2018), and pollution (UNEP, 2018). These challenges have severe impacts on the continent's ecosystems, economies, and human well-being (UNECA, 2019). Earth science education is critical in addressing these challenges by providing individuals with the knowledge, skills, and competencies needed to understand and manage the Earth's systems and resources sustainably (Huntoon & Lane, 2017). Despite the critical role of earth science education in promoting environmental sustainability, Africa continues to face significant environmental challenges. The lack of effective earth science education and awareness among African populations exacerbates these challenges, leading to inadequate management of natural resources,

increased vulnerability to environmental disasters, and decreased resilience to climate change (UNECA, 2019). Furthermore, the current state of earth science education in Africa is often characterised by inadequate infrastructure, insufficient funding, and a lack of qualified teachers, which hinders the development of a scientifically literate and environmentally conscious population (Huntoon and Lane, 2017). Therefore, there is a pressing need to harness earth science education in Africa to promote environmental sustainability, build resilience, and support sustainable development (Figure 1).

Harnessing earth science education in environmental sustainability in Africa is crucial for addressing the continent's pressing environmental challenges. This paper explored the potential of earth science education in promoting environmental sustainability in Africa, building on existing research that highlights the importance of earth science education in fostering sustainable development (Pedersen et al., 2018). By examining the current state of earth science education in Africa and identifying best practices for implementation, this paper aimed to contribute to the growing body of literature on earth science education and environmental sustainability (Kortz and van der Hoeven Kraft, 2016). The specific objectives of the study included assessing the current state of earth science education in Africa and its impact on environmental sustainability, building on existing research (Huntoon and Lane, 2017; Pedersen et al., 2018). Secondly, it aimed at identifying the key challenges and opportunities for harnessing earth science education in promoting environmental sustainability in Africa, drawing on the experiences of educators, policymakers, and practitioners (Kortz and van der Hoeven Kraft, 2016). Lastly, the study aimed at developing a framework for integrating earth science education into environmental sustainability initiatives in Africa, incorporating best practices and strategies from existing literature (UNESCO, 2019). The findings of this study would have implications for policy, practice, and future research in earth science education and environmental sustainability in Africa.



Figure 1: The Sustainable Development Goals (SDGS)

Overview of Earth Science Education in Africa

Earth science education in Africa is critical for promoting environmental sustainability, managing natural resources, and addressing the challenges of climate change (Huntoon and Lane, 2017). However, the current state of earth science education in Africa is characterised by several challenges, including limited access to quality education that is being faced by many African countries, particularly in rural and disadvantaged areas (UNESCO, 2019). Similarly, there is an inadequate infrastructure and resources including outdated textbooks, lack of laboratory equipment, and limited access to technology (Kigotho, 2017) where efforts were made to make the education available. This is complimented by shortage of qualified earth science teachers in many African countries, which can impact the quality of education and student outcomes (Bajah, 2018). Furthermore, the earth science curriculum in Africa often needs to be revised to address the specific environmental challenges and needs of the continent (Pedersen et al., 2018).

Despite these challenges, there are opportunities for improving earth science education in Africa. Such opportunities include integration of technology, such as digital resources and online learning platforms that can enhance access to quality earth science education in Africa (Kafyulilo, 2014). Such opportunities can also lead to the establishment of community-based learning

approaches that will help students to develop practical skills and apply earth science concepts to real-world problems (Machinga, 2018). In addition, partnerships and collaborations between African institutions and international organisations can provide opportunities for capacity building, resource sharing, and knowledge exchange (UNESCO, 2019). It is also worthy of note that earth science education can be designed to emphasise sustainability and environmental stewardship, promoting a culture of environmental responsibility among African students (Huntoon & Lane, 2017). By addressing the challenges and leveraging the opportunities, earth science education in Africa can play a critical role in promoting environmental sustainability and supporting the development of a more resilient and sustainable future.

Importance of Earth Science Education

Earth science education is crucial for promoting environmental sustainability in Africa. Some of the reasons why earth science education is important include, but are not limited to, understanding environmental systems, especially the complex relationships between human and natural systems, enabling the making of informed decisions about environmental management (Huntoon & Lane, 2017). Secondly, earth science education provides students with the knowledge and skills needed to address environmental challenges such as climate change, deforestation, and pollution (IPCC, 2020; FAO, 2020). Furthermore, earth science education can promote sustainable development by teaching students about the importance of sustainable resource management, environmental conservation, and social responsibility (UNESCO, 2019). In addition, earth science education help students to develop critical thinking skills, enabling them to analyse complex environmental issues and develop effective solutions (Kortz and van der Hoeven Kraft, 2016). Other importance of earth science education is in fostering environmental literacy among students, enabling them to understand the impact of human activities on the environment and make informed decisions about environmental issues (Pedersen et al., 2018). It provides students with a deep understanding of earth systems and environmental processes. Indeed, earth science education can play a critical role in promoting environmental sustainability in Africa (Figure 2).

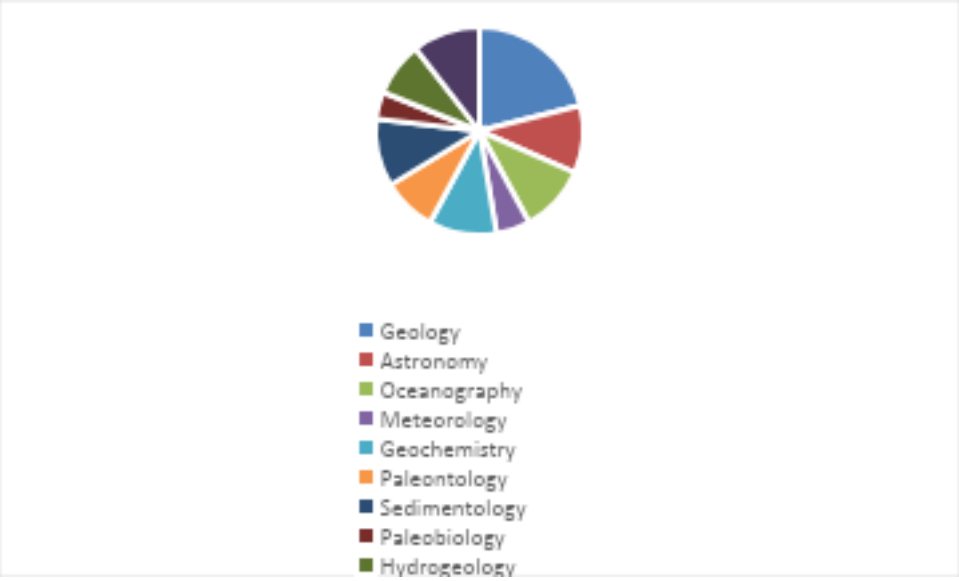


Figure 2: Some Branches of Earth Science

Environmental Sustainability Challenges in Africa

Africa faces numerous environmental sustainability challenges that impact the continent's ecosystems, economies, and human well-being. Some of the key challenges include: climate change which is a significant threat to Africa's environmental sustainability, with rising temperatures, changing precipitation patterns, and increased frequency of extreme weather events (IPCC, 2020). Deforestation and land degradation are another major environmental concern in Africa, with widespread clearance of forests for agriculture, urbanszation, and other purposes (FAO, 2020). Rich arrays of biodiversity are threatened or endangered due to habitat loss, pollution, and other human activities (IUCN, 2020). Many African countries are also faced with water scarcity challenges, with limited access to clean water for drinking, sanitation, and agriculture (UN Water, 2020). Other challenge is pollution, which is a significant environmental challenge in Africa, with air and water pollution affecting human health and the environment (UNEP, 2018). These environmental sustainability challenges have significant impact on Africa's ecosystems, economies, and human well-being, and require urgent attention and action.

Impact of Environmental Sustainability Challenges

The impact of environmental sustainability challenges facing Africa have significantly impacted the continent through environmental degradation. This leads to loss of ecosystem services, including clean air and water, soil formation, and climate regulation (MEA, 2005). Environmental sustainability challenges can impact food security, particularly in areas where agriculture is a major source of livelihood (FAO, 2020). Human health impact from pollution and degradation, including increased risk of disease and mortality, is another growing area of concern from the poorly managed environment (WHO, 2018). It is also worth mentioning that environmental sustainability challenges can have significant economic impacts that include loss of productivity, increased costs, and decreased economic opportunities (UNECA, 2019).

Impact of Human Activities on the Environment

Human activities have a significant impact on the environment, affecting ecosystems, biodiversity, and the planet's natural resources. Some of the key impacts of human activities on the environment include the burning of fossil fuels and deforestation, which have led to an increase in greenhouse gas emissions, contributing to climate change (IPCC, 2020). Human activities, such as agriculture, urbanisation, and logging, have led to widespread deforestation and land degradation, resulting in loss of biodiversity and ecosystem disruption (FAO, 2020). Activities, such as industrial processes, transportation, and waste disposal, have led to pollution of the air, water, and soil, affecting human health and the environment (UNEP, 2018). Other activities, such as over-extraction of groundwater and pollution of water sources, have led to water scarcity, affecting human consumption, agriculture, and ecosystems (UN Water, 2020). Human activities, such as habitat destruction, overfishing, and pollution, have led to loss of biodiversity, affecting ecosystem function and resilience (IUCN, 2020).

Consequences of Human Impact on the Environment

Many human activities have led to environmental degradation, affecting ecosystem function and resilience (MEA, 2005). Environmental pollution and degradation can have significant human health impacts, including increased risk of disease and mortality (WHO, 2018). Environmental degradation can also have significant economic impact, including loss of productivity,

increased costs, and decreased economic opportunities (UNECA, 2019). Similarly, environmental degradation can also have significant social impact, including displacement of communities, loss of livelihoods, and social inequality (UNDP, 2020).

Mitigating the Impact of Human Activities on the Environment

To mitigate the impact of human activities on the environment, it is essential to adopt sustainable practices and reduce environmental degradation. Some strategies for mitigating the impact of human activities on the environment involve adopting sustainable resource management practices that can help reduce environmental degradation and promote ecosystem resilience (UNEP, 2018). Transitioning to renewable energy sources can help reduce greenhouse gas emissions and mitigate climate change (IRENA, 2020) while conserving and restoring natural habitats can help promote biodiversity and ecosystem resilience (IUCN, 2020).

Role of Earth Science Education in Addressing Environmental Sustainability Challenges

Earth science education plays a critical role in addressing environmental sustainability challenges by providing individuals with the knowledge, skills, and competencies needed to understand and manage the Earth's systems and resources sustainably. Some of the ways earth science education can contribute to addressing environmental sustainability challenges include promotion of environmental literacy among students, enabling them to understand the impact of human activities on the environment and make informed decisions about environmental issues (Pedersen et al., 2018). Earth science education also helps students in developing critical thinking skills, enabling them to analyse complex environmental issues and develop effective solutions (Kortz and van der Hoeven Kraft, 2016). It fosters sustainable development by teaching students about the importance of sustainable resource management, environmental conservation, and social responsibility (UNESCO, 2019). The art of earth science education is crucial for students understanding of the causes and consequences of climate change, and development of strategies for mitigating and adapting to its impacts (IPCC, 2020).

It can promote sustainable resource management by teaching students about the importance of conserving and managing natural resources sustainably (UNEP, 2018).

Strategies for Integrating Earth Science Education into Environmental Sustainability Initiatives

Integrating earth science education into environmental sustainability initiatives can help promote sustainable development and environmental conservation. Some strategies for integrating earth science education into environmental sustainability initiatives may involve integrating earth science education with other disciplines, such as biology, chemistry, and social sciences, which can provide a holistic understanding of environmental sustainability issues (UNESCO, 2019). Using project-based learning approaches can help students develop practical skills and apply earth science concepts to real-world environmental sustainability challenges (Kortz & van der Hoeven Kraft, 2016). Community-based learning approaches can help students develop a deeper understanding of environmental sustainability issues and promote community engagement and participation (Machinga, 2018). Incorporating local contexts and case studies into earth science education can help students understand the relevance of earth science concepts to environmental sustainability issues in their own communities (Pedersen et al., 2018). Using technology, such as digital resources and online learning platforms, can enhance access to earth science education and promote environmental sustainability (Kafyulilo, 2014).

Benefits of Integrating Earth Science Education into Environmental Sustainability Initiatives

The benefit of integrating earth science education into environmental sustainability initiatives embraces integrating earth science education into environmental sustainability. Such initiatives can promote sustainable development and environmental conservation (UNESCO, 2019). Earth science education can help students develop environmental literacy, enabling them to understand the impact of human activities on the environment (Huntoon and Lane, 2017). Furthermore, integrating earth science education into environmental sustainability initiatives can foster critical thinking and problem-solving skills among students (Kortz and van der Hoeven Kraft, 2016).

Challenges and Opportunities

While integrating earth science education into environmental sustainability initiatives offers many benefits. There are also challenges and opportunities to consider. Some of these include limited resources, including funding and infrastructure (Kigotho, 2017). Interdisciplinary collaboration between earth science educators and environmental sustainability practitioners can provide opportunities for developing innovative and effective solutions (UNESCO, 2019).

Inadequate infrastructure, including classrooms, laboratories, and technology can hinder the implementation of earth science education programmes (UNEP, 2018) while a lack of trained teachers and educators can pose challenges to implementing earth science education programmes, particularly in rural and underserved areas (UNESCO, 2019). Cultural and linguistic barriers can equally affect the effectiveness of earth science education programmes, particularly in diverse and multilingual contexts (UNESCO, 2019). Other factor is the passive threat of the indigenous as a result of limited community engagement and participation because of their skills. This is capable of hindering the effectiveness of earth science education programmes and limiting their impact on environmental sustainability (Machinga, 2018).

Best Practices for Implementation

Implementing earth science education for environmental sustainability in Africa requires careful planning, collaboration, and stakeholder engagement. The best practices for the implementation of earth science education in environmental sustainability in Africa will involve engagement with local communities, governments, and other stakeholders to ensure that earth science education programmes are relevant, effective, and sustainable (UNESCO, 2019). The use of interdisciplinary approaches that integrate earth science education with other disciplines, such as biology, chemistry, and social sciences, to provide a holistic understanding of environmental sustainability issues (Pedersen et al., 2018), would be crucial. Practical training and hands-on experience for students to develop skills and apply earth science concepts to real-world environmental sustainability challenges should be a must for them (Kortz & van der Hoeven Kraft, 2016). Capacity-building programmes for teachers, educators, and community leaders to enhance their knowledge and skills in earth science education and environmental sustainability should

be formulated (SAEON, 2020). A continuous monitoring and evaluation framework to assess the effectiveness of earth science education programmes and identify areas for improvement (UNEP, 2018) is of utmost importance for the successful implementation.

Alignment of Earth Science Education with SDGs

Earth science education can contribute significantly to achieving the Sustainable Development Goals (SDGs), particularly those related to environmental sustainability and climate action. Earth science education can help students understand the causes and consequences of climate change, and develop strategies for mitigating and adapting to its impact (IPCC, 2020). Secondly, earth education can also support the achievement of SDG 14, which deals with life below water. Earth science education can promote understanding of ocean systems, marine ecosystems, and the impact of human activities on the ocean environment (UNESCO, 2019). Thirdly, it can also significantly enhance SDG 15, which deals with life on land. Earth science education can help students understand the importance of terrestrial ecosystems, biodiversity, and sustainable land management practices (UNEP, 2018).

Addressing the Challenges

To address the challenges earlier highlighted, it is essential to build partnerships with governments, civil society, and the private sector to leverage resources and expertise (AFR100, 2020). It is equally important to develop contextualised curricula that take into account local cultures, languages, and environmental sustainability issues (Pedersen et al., 2018). Government and corporate bodies would have to invest in infrastructure, including classrooms, laboratories, and technology, to support the implementation of earth science education programmes (UNEP, 2018). The teachers should be provided with training and capacity-building programmes to enhance the knowledge and skills of educators in earth science education and environmental sustainability (SAEON, 2020).

Educational Strategies

An interdisciplinary approach is a pivotal strategy in educational sustainability, connecting all aspects of earth science with life sciences, social sciences, economics, ethics, and policy. Place-based learning that involves

teaching through local environmental issues will help in managing communities with peculiar challenges. Engaging students in real-world sustainability challenges through project-based learning should be encouraged. Use of technology and modeling tools, such as GIS, remote sensing, and simulations to understand mitigation and sustainability, is crucial.

Roles of Students

The role of students in environmental sustainability is important considering their ability to combine education, action and innovation. Students are brought to enhance understanding the interconnections in Earth's systems, critical thinking, problem-solving skill, collaboration and communication, ethical reasoning and civic responsibility (Figure 3). Students play important role as learners, change- agents and future stewards of the earth. By being well educated, equipped, responsible and proactive, they can drive meaningful and impactful change and help build a more sustainable world.



Figure 3: Some students and a tutor studying the environment in part of Northcentral Nigeria

Opportunities for Collaboration and Partnership

Collaboration and partnership are essential for harnessing earth science education to promote environmental sustainability in Africa. Some opportunities for collaboration and partnership include:

Government-Private Sector Partnerships that involved partnering with governments and the private sector to provide access to resources, expertise, and funding for earth science education initiatives (AFR100, 2020). Collaborating with international organisations and institutions can provide access to global best practices, expertise, and resources for earth science education (UNESCO, 2019). Engaging with local communities and stakeholders can help ensure that earth science education initiatives are relevant, effective, and sustainable (Machinga, 2018). Partnering with other disciplines, such as biology, chemistry, and social sciences, can provide a holistic understanding of environmental sustainability issues (Pedersen et al., 2018). Others include utilising digital platforms and technologies that provide opportunities for collaboration, knowledge sharing, and capacity building in earth science education (Kafyulilo, 2014).

Benefits of Collaboration and Partnership

The benefits of collaboration and partnership in earth science education for environmental sustainability helps in providing access to increased resources, including funding, expertise, and infrastructure (AFR100, 2020). Collaboration and partnership can improve the effectiveness of earth science education initiatives by leveraging global best practices and expertise (UNESCO, 2019). It enhances the sustainability of earth science education initiatives by promoting community engagement and ownership (Machinga, 2018).

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Conclusion

Implementing earth science education for environmental sustainability in Africa requires careful planning, collaboration, and stakeholder engagement. By addressing the challenges and leveraging opportunities, promotion of sustainable development and environmental conservation in Africa can be achieved. Schools and universities should emphasise integrating sustainability into earth and environmental science programmes. The role of teachers, lecturers and researchers are important for continuous learning. Adherence to government policies, implementation government laws and community partnerships for sustainability projects like international programs can foster and improve environmental sustainability. Collaboration and partnership are essential for harnessing earth science education to promote environmental sustainability in Africa. By leveraging resources, expertise, and funding, effective earth science education initiatives that promote sustainable development and environmental conservation can be developed.

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CHAPTER NINETEEN

Adult Perspectives on Street Begging in Sango, Ilorin: Public Health, Social Vulnerability, and Sustainable Policy Implications

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Abstract

Street begging poses public health and social sustainability challenges, especially in low- and middle-income countries like Nigeria. Its local causes and effects are underexplored. It is against this background that this study sought to assess perceived causes, consequences, and mitigation strategies for street begging among adults in Sango, Ilorin, Nigeria. The study adopted a cross-sectional design with 460 adults selected through a multistage sampling procedure for a structured interview, using a semi-structured interviewer-administered questionnaire. Data collected were analysed using descriptive statistics and chi-square tests at $p<0.05$. Poverty, disability, and family breakdown were found to be the key causes of street begging, while consequences included sexual violence and assault. The study recommended that street begging reflects deep-rooted social vulnerabilities needing sustainable policy solutions like the establishment of destitute centres and the provision of financial aid for the destitute and disabled.

Keywords: Homeless Persons, Poverty, Public Health, Welfare Services.

Introduction

Street begging is a persistent global issue with deep socio-economic and public health implications. While prevalent in many low- and middle-income countries, it takes on particularly troubling dimensions in Nigeria where structural inequalities, poverty, cultural factors, and weakened social systems converge to drive the phenomenon. According to Stones (2013), while poverty remains the most cited precipitant of begging, psychosocial factors such as

stigma, disempowerment, and exclusion are equally critical. Street begging in Nigeria—commonly known as *Bara* or *Maula* —is particularly pronounced in the north and continues to grow despite legal and social deterrents (Fawole et al., 2011).

The phenomenon increasingly includes not only people with visible disabilities but also able-bodied individuals, children, and entire families using strategic locations—markets, mosques, and traffic intersections—as sites of solicitation. Agyemang et al. (2024) underscored the evolving nature of the street begging economy, identifying it as a form of informal employment with embedded survival strategies, social networks, and resource-sharing dynamics. This evolution reflects a shift from mere destitution to a semi-organised livelihood, further complicating intervention strategies.

Ilorin Metropolis, located in Kwara State, is one of Nigeria's rapidly urbanizing centers grappling with this issue. Existing studies, such as Tambawal (2012) and Onoyase (2010), suggested that ineffective enforcement, inadequate social protection, and religious leniency have contributed to the normalisation of street begging. Beggars often exploit religious sensibilities and societal empathy to sustain this practice, creating a complex interplay between vulnerability and opportunism. Despite the visibility of beggars across the city, there is limited empirical data addressing the public's perception of the causes, consequences, and possible interventions—particularly from within affected communities.

This study, therefore, sought to fill this gap by assessing the perceived drivers and consequences of street begging in a Hausa-dominated community in Ilorin, triangulating these insights with socio-cultural, public health, and policy perspectives. By identifying context-specific factors and locally endorsed intervention strategies, this work contributed to a sustainable and community-informed approach to mitigating street begging.

Methodology

This descriptive cross-sectional study was conducted between February and March 2024 among adult residents of the Sango community in Ilorin Metropolis, Kwara State. The location was purposively chosen for its high prevalence of street begging, especially among Hausa migrants. A sample size of 460 was determined using Fisher's formula, accounting for a confidence

level of 95% and an estimated prevalence of 50% due to the lack of prior localised data.

A multistage sampling technique was employed. First, Sango was selected as the study community. Next, systematic random sampling was used to identify households, and one eligible adult per household was randomly selected for participation. Eligibility criteria included adults aged 18 and above who had lived in the community for at least one year.

Data were collected over six weeks, using a semi-structured interviewer-administered questionnaire, which captured socio-demographic data, perceived causes and consequences of street begging, and opinions on mitigation strategies. The tool was adapted from previous instruments used in similar studies (Fawole et al., 2011; Ekebosi et al., 2021) and further enriched using concepts from the studies by Stones (2013) and Agyemang et al. (2024) regarding psychosocial and economic dynamics.

The questionnaire was pre-tested in Offa, a nearby community, using 10% of the final sample size. Necessary adjustments were made for cultural sensitivity and clarity. Ethical approval was obtained from the Ethical Review Committee of the University of Ilorin with the approval number UERC/ASN/2024/2680. Written informed consent was obtained from all participants.

Data were analysed using STATA version 11. Descriptive statistics were presented in frequencies and percentages, while chi-square tests were used to assess associations between categorical variables. Logistic regression was used to identify predictors of street begging. A p-value < 0.05 was considered statistically significant.

Results

Table 1: Socio-demographic Profile of Respondents in the Study Population

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	< 20	42	9.2%
	20 – 39	200	44.0%
	40 – 59	179	39.3%

Variable	Category	Frequency (n)	Percentage (%)
	≥ 60	34	7.5%
Gender	Male	222	48.8%
	Female	233	51.2%
Tribe	Yoruba	85	18.7%
	Hausa	359	78.9%
	Igbo	3	0.7%
	Other	8	1.7%
Religion	Islam	427	93.9%
	Christianity	26	5.7%
	Other	2	0.4%
Marital Status	Single	96	21.1%
	Married	285	62.6%
	Divorced	74	16.3%
Education Level	Primary	102	22.4%
	Secondary	136	29.9%
	Tertiary	41	9.0%
	Other (e.g., informal education)	176	38.7%
Type of Housing	Mud	8	1.8%
	Mud plastered with cement	125	27.5%
	Block	305	67.0%
	Wooden	17	3.7%
Occupation	Civil Servant	23	5.1%
	Personal Business	275	60.4%

Variable	Category	Frequency (n)	Percentage (%)
	Housewife	78	17.2%
	Artisans	27	5.9%
	Unemployed	52	11.4%

Table 1 outlines the socio-demographic characteristics of the 455 respondents. The majority (44.0%) were aged between 20 and 39 years, with slightly more female (51.2%) than male. Most respondents were Hausa (78.9%) and predominantly Muslim (93.9%), reflecting the cultural and religious demographics of the study area. A large proportion were married (62.6%), and education levels were varied, though a notable 38.7% had only informal or unspecified education. Most respondents lived in block houses (67.0%), indicating moderate housing quality. Economically, the dominant occupation was personal business (60.4%), while 11.4% were unemployed. These demographics suggest a youthful, economically active, yet educationally diverse population, with potential social vulnerabilities influencing practices like street begging.

Table 2: Prioritized Perceptions of the Underlying Causes of Street Begging Among Respondents

Perceived Causes	Strongly Agree (SA)	Agree (A)	Total Agreement (SA + A)
Poverty	276 (60.7%)	150 (32.9%)	426 (93.6%)
Physical disability	83 (18.2%)	279 (61.3%)	362 (79.5%)
Death of both parents / Family disintegration	53 (11.7%)	247 (54.3%)	300 (66.0%)
Lack of old age security	48 (10.5%)	195 (42.9%)	243 (53.4%)
Religious obligation	62 (13.6%)	175 (38.5%)	237 (52.1%)

Perceived Causes	Strongly Agree (SA)	Agree (A)	Total Agreement (SA + A)
Treating sickness	69 (15.2%)	173 (38.0%)	242 (53.2%)
Children's education	66 (14.5%)	164 (36.0%)	230 (50.5%)
Lack of caring relatives	77 (16.9%)	163 (35.8%)	240 (52.7%)
Source of livelihood	78 (17.1%)	156 (34.3%)	234 (51.4%)
Health problems	49 (10.7%)	180 (39.6%)	229 (50.3%)
Unemployment	50 (11.0%)	161 (35.4%)	211 (46.4%)
Family rejection	52 (11.4%)	178 (39.2%)	230 (50.6%)
Old age	50 (11.0%)	200 (43.9%)	250 (54.9%)
Homelessness	49 (10.8%)	165 (36.3%)	214 (47.1%)
National disaster	56 (12.3%)	162 (35.6%)	218 (47.9%)
Culture	61 (13.4%)	176 (38.7%)	237 (52.1%)
Family heritage	48 (10.5%)	182 (40.0%)	230 (50.5%)
Considering begging as a job	49 (10.8%)	175 (38.5%)	224 (49.3%)
Rural-urban migration	61 (13.4%)	173 (38.0%)	234 (51.4%)

Perceived Causes	Strongly Agree (SA)	Agree (A)	Total Agreement (SA + A)
Civil war	65 (14.3%)	169 (37.1%)	234 (51.4%)
Psychiatric disorder	58 (12.8%)	172 (37.8%)	230 (50.6%)

Table 2 presents respondents' perceptions of the causes of street begging, with poverty identified as the most significant factor (93.6% agreement), followed by physical disability (79.5%) and family breakdown (66.0%). Health-related factors, lack of social support, and religious obligations were also widely acknowledged. Surprisingly, factors like unemployment, homelessness, and considering begging a livelihood were agreed upon by nearly half of respondents. Cultural beliefs, psychiatric issues, and civil conflict were also moderately endorsed. These findings suggest that street begging is perceived as a consequence of both structural socio-economic challenges and individual or familial vulnerabilities, underscoring the need for multidimensional intervention strategies.

Table 3: Perceived Risks and Vulnerabilities Linked to Street Begging Among Respondents

Perceived Consequences	SA n(%)	A n(%)	N n(%)	D n(%)	SD n(%)
Sexual violence	171(37.6)	149(32.8)	11(2.4)	52(11.4)	72(15.8)
Accident	59(12.9)	258(56.8)	8(1.7)	85(18.7)	45(9.9)
Physical assault	45(9.9)	266(58.5)	6(1.3)	92(20.2)	46(10.1)
Victim of crime	54(11.9)	219(48.1)	9(2.0)	93(20.4)	80(17.6)
Harsh weather	87(19.1)	195(42.9)	6(1.3)	86(18.9)	81(17.8)
Verbal abuse	73(16.0)	199(43.7)	6(1.4)	100(22.0)	77(16.9)
Harassment from municipal officials and police	79(17.4)	207(45.5)	6(1.3)	95(20.9)	68(14.9)

Harassment from fellow Beggers	64(14.0)	208(45.7)	8(1.8)	98(21.6)	77(16.9)
Discrimination and stigmatization	81(17.8)	221(48.6)	7(1.5)	93(20.4)	53(11.7)
Problems of shelter and food	77(16.9)	192(42.2)	9(2.0)	76(16.7)	101(22.2)

Table 3 highlights respondents' perceptions of the adverse consequences linked to street begging. Sexual violence was strongly acknowledged, with 70.4% either strongly agreeing or agreeing to its prevalence. Physical assault (68.4%) and accidents (69.7%) were also widely recognised dangers. Other significant concerns included exposure to harsh weather, verbal abuse, and harassment from both authorities and fellow beggars. Discrimination and stigmatisation were acknowledged by 66.4% of respondents. Notably, while problems of shelter and food were recognised, agreement levels were slightly lower (59.1%). Overall, the data underscored that street begging is perceived as exposing individuals to multiple physical, emotional, and social harms.

Table 4: Respondents' Perceptions of Effective Strategies for Mitigating Street Begging

Perceived Measures of Mitigating Street Begging	YES n(%)	NO n(%)
Establishment of destitute centres	407(89.4)	48(10.6)
Payment of allowances to disabled persons	352(77.4)	103(22.6)
Strengthening of social welfare agencies across the state	304(66.8)	151(33.2)
Forcing beggars out of the streets	272(59.9)	183(40.2)
Arresting anyone found begging on the public streets	257(56.5)	198(43.5)
Establishment of financial assistance programmes for the less privileged in the state	270(59.3)	185(40.7)
Religious control measures	272(59.8)	183(40.2)

Table 4 illustrates respondents' perspectives on various strategies to mitigate street begging. The most supported measure is the establishment of destitute centers (89.4%), followed by financial support for disabled persons (77.4%) and strengthening of social welfare agencies (66.8%). While a majority also favoured enforcement-based strategies such as forcing beggars off the streets (59.9%) and arrests (56.5%), these approaches received comparatively less support. Just under 60% advocated for financial assistance programmes and religious control measures. Overall, the findings suggested that while there is strong support for welfare-driven interventions, a considerable proportion of respondents also endorsed punitive or regulatory measures.

Table 5: Demographic Profile and Frequency of Street Begging Among Respondents

Variable	Frequency	Percentage
Ever Engaged in Street Begging		
Yes	119	26.0
No	336	74.0
Duration of Onset of Street Begging (Years)		
< 1	60	50.4
1 - 4	36	30.3
> 4	23	19.3
Age at Onset of Street Begging		
< 18	84	70.6
≥ 18	35	29.4
Currently Engaged in Street Begging		
Yes	119	26.0
No	336	74.0
Other Family Members Engage in Street Begging		
Yes	96	80.7
No	23	19.3

Family Members Practicing Street Begging	38	39.6
Spouse	38	39.6
Children	20	20.8
Others	101	84.9
Frequency of Practice of Street Begging	18	15.1
Everyday		
Once a while		

Table 5 presents data on respondents' involvement in street begging, revealing that 26% engaged in the practice, with most beginning before age 18 (70.6%). Among those who begged, over half had done so for less than a year, suggesting a recent surge or transient need. A significant proportion (26%) were still actively begging, and 80.7% reported having other family members also involved, indicating intergenerational or household-level dependence. Spouses and children were equally represented among family beggars. The majority (84.9%) begged daily, emphasising the severity and regularity of the practice. These findings highlight the entrenched and systemic nature of street begging.

Table 6: Demographic Correlates of Street Begging Among Respondents

Variable	Practice		Total	χ^2	p-value
	Yes	No	N= 455(100%)		
	n=119 (26%)	n=336 (74%)			
Age in years					
<20	13(30.9)	29(69.1)	42(9.2)		
20-39	58(29.0)	142(71.00)	200(434.0)		
40-59	40(22.4)	139(77.6)	179(39.3)		
60 and above	8(23.5)	26(76.5)	34(7.5)	2.8044	0.423
Gender					
Male	42(18.9)	180(81.1)	222(48.8)		

Female	77(33.1)	156(66.9)	233(51.2)	11.7493	**0.001**
Tribe					
Yoruba	32(37.6)	53(62.4)	85(18.7)		
Hausa	86(24)	273(76.0)	359(78.9)		
Igbo	0(0.0)	3(100.0)	3(0.7)		
Other	1(12.5)	7(87.5)	8(1.7)	8.5466	**0.036**
Religion					
Islam	110(25.8)	317(74.2)	427(93.9)		
Christianity	9(34.6)	17(65.4)	26(5.7)		
Others	0(0.0)	2(100.0)	2(0.4)	1.7063	0.426
Marital status					
Single	34(35.4)	62(64.6)	96(21.1)		
Married	61(21.4)	224(78.6)	285(62.6)		
Divorced	24(32.4)	50(67.6)	74(16.3)	9.1051	**0.011**
Education status					
Primary	24(23.5)	78(76.5)	102(22.4)		
Secondary	39(28.7)	97(71.3)	136(30.0)		
Tertiary	12(29.3)	29(70.7)	41(9.0)		
Others	1(8.3)	11(91.7)	12(2.6)		
None	43(26.2)	121(73.8)	164(36.0)	2.9913	0.559
Type of house					
Mud	1(12.5)	7(87.5)	8(1.8)		
Mud plastered with cement	41(32.8)	84(67.2)	125(27.5)		
Block	73(23.9)	232(76.1)	305(67.0)		
Wooden	4(23.5)	13(76.5)	17(3.7)	4.4695	0.215

Occupation					
Civil servant	7(30.4)	16(69.6)	23(5.1)		
Personal business	69(25.1)	206(74.9)	275(60.4)		
Housewife	20(25.6)	58(74.4)	78(17.1)		
Artisans	9(33.3)	18(66.7)	27(6.0)		
Unemployed	14(26.9)	38(73.1)	52(11.4)	1.1263	0.890
Average monthly income					
<10.000	106(26.7)	291(73.3)	397(87.3)		
10,000 – 50,000	5(15.6)	27(84.4)	32(7.0)		
>50,000	8(30.8)	18(69.2)	26(5.7)	2.1849	0.335

Table 6 presents the relationship between respondents' demographic characteristics and their involvement in street begging. Significant associations were found with gender, tribe, and marital status. A higher proportion of female (33.1%) engaged in street begging compared to male (18.9%), indicating a gender-based vulnerability ($p = 0.001$). Tribal affiliation was also significant ($p = 0.036$), with the Yoruba group showing the highest involvement (37.6%), while no Igbo respondents reported engaging in begging. Marital status showed a notable association ($p = 0.011$), as single and divorced individuals were more likely to beg than their married counterparts.

Although not statistically significant, trends suggest that younger individuals, those with no education, and those earning less than ₦10,000 monthly are more likely to engage in street begging. Similarly, those in mud-plastered houses and unemployed or informal workers showed higher rates of begging. However, religion, education level, type of housing, occupation, age, and income did not show significant statistical associations. These findings highlighted that while economic factors are relevant, social and cultural variables such as gender roles, marital status, and ethnicity play a stronger role in influencing street begging behaviour in this population.

Discussion

This study offered a nuanced understanding of the multifactorial drivers and consequences of street begging in Ilorin, Nigeria. Poverty was overwhelmingly perceived as the main cause (93.6%), consistent with findings by Stones (2013) and Agyemang et al. (2024), who described poverty as both a trigger and a sustainer of begging economies. The recognition of physical disability (79.5%) and family disintegration (66.0%) as significant contributors aligns with global literature on structural vulnerability (Tambawal, 2012; Ekebosi et al., 2021).

Interestingly, the findings also highlighted the influence of religious obligation and cultural practices in sustaining begging, echoing Onoyase's (2010) observation that religious sympathy often enables the practice under the guise of charity. This duality—where beggars exploit religious beliefs while the public feels morally obliged to give—creates a persistent enabling environment.

The perceived consequences of begging, such as exposure to sexual violence (70.4%), accidents (69.7%), and physical assault (68.4%), resonate with Hasibuan et al. (2020), who documented the physical and emotional abuse faced by street children in Indonesia. This suggests that beyond economic deprivation, street begging exposes individuals—particularly women and children—to heightened health and safety risks.

The widespread support for establishing rehabilitation centers (89.4%) and financial assistance for the disabled (77.4%) underscores public awareness of the structural causes and a preference for social interventions over punitive ones. Nonetheless, the relatively high endorsement of coercive measures, such as arrests (56.5%) and street clearance (59.9%), reflects an underlying tension between empathy and fatigue among urban dwellers, a sentiment similarly noted by Stones (2013).

Demographic associations, such as the higher prevalence of begging among females, single/divorced individuals, and the Yoruba ethnic group, revealed gendered and cultural dimensions of vulnerability. Although education and income were not significantly associated, the high proportion of beggars with no or low formal education points to limited economic mobility and capacity for self-reliance.

In triangulating these findings, it becomes evident that street begging in Ilorin is not merely a result of individual failings but reflects broader systemic dysfunctions. The normalisation of begging as a livelihood strategy, as described by Agyemang et al. (2024), mirrors the evolution seen in Ghana and other urban contexts. Hence, effective interventions must transcend short-term relief and incorporate sustainable development, education, skills empowerment, and inclusive social welfare systems.

Limitations

This study is not without limitations. Firstly, it was geographically confined to the Sango community within Ilorin, which may limit the generalisability of the findings to other regions with different socio-cultural, economic, and religious compositions. Secondly, the reliance on self-reported data introduced potential response biases, including social desirability bias and recall inaccuracies, which might have affected the reliability of participants' responses. The use of a cross-sectional design also restricted the ability to establish causal relationships between the identified sociodemographic factors and engagement in street begging. Furthermore, the study employed a predominantly quantitative approach, which might not fully capture the subjective experiences, motivations, and emotional realities of individuals involved in street begging. Future studies may benefit from mixed-methods designs and broader geographical coverage to enrich and validate these findings.

Implications for Policy and Practice

The findings of this study carry significant implications for both policy development and practical interventions aimed at addressing the persistent issue of street begging in urban Nigerian settings. First and foremost, the widespread public support for welfare-based solutions, such as the establishment of rehabilitation centers and financial assistance for persons with disabilities, highlights an urgent need to strengthen and expand social protection systems. Policymakers are therefore encouraged to invest in comprehensive and inclusive welfare programmes that target vulnerable populations, particularly individuals with disabilities, single-parent households, and street-involved families.

Furthermore, the health risks associated with street begging, such as sexual violence, physical assault, exposure to harsh environmental conditions, and

inadequate access to basic healthcare, demonstrate the necessity of framing street begging as a pressing public health issue. Integrating street populations into public health outreach initiatives, including routine immunisation, mental health services, and mobile clinics, could contribute significantly to mitigating these risks and improving community well-being.

In addition, the findings suggest that economic empowerment and education are vital for breaking the cycle of dependency associated with begging. Vocational training and skills acquisition programmes tailored to low-income urban residents could offer meaningful alternatives to begging, especially for women and youth. Such initiatives would not only foster self-reliance but also reduce the intergenerational transmission of poverty and social marginalization.

While some respondents expressed support for punitive measures, such as arrests or the forced removal of beggars, the broader data advocated for a more balanced and humane approach. Legal reforms should move away from criminalising begging and instead prioritise mechanisms that connect individuals to support services, thereby aligning with human rights and social justice principles.

Finally, the cultural and religious dimensions of street begging call for the active engagement of faith-based organizations and community leaders. These institutions can play a pivotal role in reshaping public perceptions, promoting dignity-centered interventions, and advocating for compassionate responses to poverty and vulnerability.

Conclusion

Street begging in Ilorin is deeply rooted in socio-economic deprivation, cultural norms, and weak social support systems. This study demonstrated that the practice is both a livelihood strategy and a manifestation of structural inequality. With a high prevalence of health and social vulnerabilities among beggars, there is a clear public demand for sustainable solutions that blend compassion with systemic reform. Interventions must prioritise the establishment of inclusive social welfare programs, healthcare access, education, and skills empowerment while addressing cultural and religious dimensions. Ultimately, tackling street begging requires a coordinated, multi-sectoral, multi-dimensional approach that balances social responsibility with public health imperatives.

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CHAPTER TWENTY

Global University Networks: Strengthening Collective Impact in Higher Education

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Abstract

Global University Networks (GUNs) are increasingly vital strategic alliances that enable higher education to tackle complex global challenges. They amplify collective impact through cross-border collaboration, resource sharing, and innovation. GUNs enhance educational quality, cultivate global perspectives, and improve graduate employability via student and faculty exchange, joint degrees and shared resources, driving groundbreaking research and solutions for global issues. Despite their potential, GUNs face hurdles such as technological disparities, administrative complexities, and the need for equitable partnerships. Future success hinges on embracing hybrid learning, digital credentials, and skills-based education aligned with the United Nations' Sustainable Development Goals (SDGs). By developing robust digital platforms and fostering inclusive, bottom-up relationships, GUNs can effectively leverage their strengths. Case studies, including the Association of Pacific Rim Universities and Universitas 21, demonstrated their tangible impact in advancing academic excellence and social responsibility. Strengthening these networks requires an ongoing commitment to inclusivity and alignment with global development objectives.

Keywords: Collaboration; Partnership; Digital credential; Skills-based education; Solution

Introduction

In an era defined by rapid globalisation, unprecedented technological advancements, and a growing array of complex, interconnected global challenges, the traditional role and operational model of higher education institutions are undergoing a profound transformation (Rehman, 2025). Universities, once primarily seen as localised centers of learning and research, are increasingly recognising that isolation is no longer a viable or effective strategy for progress. The pressing issues of the 21st century, ranging from

climate change and global pandemics to economic inequalities and technological disruption, demand a collective, interdisciplinary, and international response that no single institution can adequately provide on its own. This paradigm shift has given rise to the strategic imperative of Global University Networks (GUNs), which are emerging as pivotal mechanisms for fostering deeper international collaboration, facilitating resource sharing, and amplifying the collective impact of higher education worldwide (Annapareddy, 2025).

The concept of university collaboration is not new, but the scope, scale, and strategic intent behind contemporary GUNs represent a significant evolution. These networks move beyond traditional bilateral partnerships to create multifaceted, often multi-continental, alliances designed to achieve shared objectives that transcend individual institutional capabilities. They are born from the recognition that pooling intellectual capital, diverse perspectives, and specialised resources across geographical and cultural boundaries can unlock innovative solutions, enrich educational experiences, and accelerate research breakthroughs at a pace unachievable through solitary efforts. The very fabric of global society is now interwoven with intricate supply chains, digital communications, and shared cultural narratives, making it incumbent upon educational institutions to mirror and actively shape this interconnected reality (Rådberg & Löfsten, 2024).

The core motivation behind the proliferation of GUNs is the pursuit of collective impact, the idea that multiple organizations working together on a common agenda, with shared measurement, continuous communication, and mutually reinforcing activities, can achieve significant and lasting social change. Within the context of higher education, this translates into a powerful synergy where universities collaboratively address global grand challenges, enhance the quality and relevance of education, foster a globally competent workforce, and promote cultural understanding. Whether tackling sustainable development goals, advancing cutting-edge scientific research, or developing innovative pedagogical approaches, GUNs provide the infrastructure and framework for concerted action (Jones et al., 2021).

This study examined the multifaceted dimensions of Global University Networks, establishing their critical role in an increasingly complex world. It explored how these networks function as platforms for enriching educational

curricula through diverse global perspectives, facilitating large-scale collaborative research initiatives that tackle urgent societal problems, and enhancing graduate employability by instilling essential cross-cultural competencies and adaptive skills (Chowdhury & Alzarrad, 2025). Furthermore, it examined how GUNs serve as vital conduits for cultural exchange and global networking, building crucial interpersonal and institutional connections that underpin future collaborations. By examining the transformative potential inherent in these strategic alliances, this study aimed to underscore why Global University Networks are not merely an optional add-on but an indispensable component of a resilient, responsive, and impactful higher education landscape in the 21st century. Their continued growth and evolution are essential for shaping a future where education actively drives progress, fosters global citizenship, and collectively addresses humanity's most pressing concerns (Tuba, 2023). Some of the available GUNs are presented in Table 1.

Characteristics of Global University Networks

Global University Networks (GUNs) are dynamic and evolving entities, characterised by several key features that distinguish them from traditional bilateral university partnerships. These characteristics enable them to achieve a greater collective impact in the complex global landscape of higher education:

a) Multilateral and Diverse Membership: Unlike simple bilateral agreements, GUNs typically involve three or more or sometimes hundreds of institutions from various countries and regions. This diversity in membership brings a rich array of academic strengths, cultural perspectives, and research specialisations, fostering a more comprehensive approach to global challenges. Members can range from large research-intensive universities to smaller specialised institutions (Acac, 2024).

b) Shared Vision and Strategic Alignment: Effective GUNs are built upon a common strategic vision and shared objectives. Members align their institutional goals with the network's overarching mission, which often revolves around specific themes such as sustainable development, global health, digital transformation, or fostering global citizenship. This alignment ensures that collaborative efforts are

purposeful and directed towards significant collective outcomes (Bowser et al., 2024).

c) Collaborative Programmes and Initiatives: The core of GUNs lies in their active collaborative programmes (Rehman, 2025). These can include:

   i. Joint Research Projects: Pooling expertise and resources to conduct interdisciplinary research on global issues.

   ii. Student Mobility and Exchange: Facilitating opportunities for students to study abroad, gain international experience, and earn credits or joint/dual degrees.

   iii. Faculty Mobility and Collaboration: Enabling faculty to teach, research, and collaborate across institutions, sharing best practices and developing joint curricula.

   iv. Shared Curricula and Joint Degree Programmes: Developing common academic programmes or offering degrees jointly, enhancing the global relevance and appeal of qualifications.

   v. Resource Sharing: Accessing specialised facilities, libraries, digital resources, and expertise across the network.

   vi. Capacity Building: Supporting less resourced institutions within the network through knowledge transfer, training, and infrastructure development.

d) Flexible Governance and Operational Structures: GUNs adopt various governance models, ranging from loosely affiliated consortia to more formally structured entities with dedicated secretariats and clear decision-making processes. Flexibility is key to accommodating the diverse legal, administrative, and academic frameworks of member institutions. Effective governance ensures accountability, transparency, and the efficient allocation of resources.

e) Leveraging Technology for Connectivity: Digital technologies are fundamental enablers for GUNs. They facilitate virtual collaboration, remote learning, shared digital platforms for course delivery, data exchange, and seamless communication across time zones. This characteristic has become even more pronounced with the rise of

hybrid and virtual learning models, making geographical distance less of a barrier.

f) Focus on Global Relevance and Impact: A defining characteristic is their commitment to addressing issues of global significance. GUNs aim to contribute tangibly to societal progress, whether through research influencing policy, developing innovative solutions, or educating graduates equipped to navigate and contribute to a globalised world. Many align their efforts with frameworks like the UN Sustainable Development Goals (SDGs).

Voluntary Participation and Mutual Benefit: Membership in GUNs is typically voluntary, driven by the perceived mutual benefits for participating institutions. These benefits can include enhanced reputation, increased student and faculty recruitment, access to funding.

Table 1: Some Global University Networks

Network Name	Primary Focus / Mission	Key Characteristics	Examples of Member Universities (Illustrative)
Universitas 21 (U21)	Fostering global collaboration for research, education, and innovation.	Research-intensive, diverse global membership, focus on student experience and future leaders.	University of British Columbia, University of Glasgow, National University of Singapore, University of Melbourne
Worldwide Universities Network (WUN)	Addressing global challenges through international research collaboration and education.	Strong emphasis on interdisciplinary research programs, global policy impact.	University of Leeds, University of Wisconsin-Madison, University of Sydney, Zhejiang University
International Alliance of Research Universities	Promoting research collaboration and education among leading research-	Highly selective, focus on shared research infrastructure and	University of Cambridge, Yale University, Peking University, Australian

(IARU)	intensive universities.	student mobility.	National University
Matariki Network of Universities (MNU)	Enhancing diversity, sharing ideas, and learning best practices among research-intensive universities with a commitment to a broad-based education.	Emphasizes a "rounded education" and excellence in scholarship.	Dartmouth College, Durham University, Queen's University (Canada), University of Western Australia
McDonnell International Scholars Academy	Connecting leading global universities through faculty and student exchange to address global challenges.	Focus on graduate student exchange and research collaboration, particularly with Washington University in St. Louis as the hub.	Washington University in St. Louis, Fudan University, Hebrew University of Jerusalem, Indian Institute of Technology Bombay
Global Network for Advanced Management (GNAM)	Connecting leading business schools worldwide to foster global understanding and innovation in management education.	Primarily focused on business education, student and faculty exchanges, global case studies, and dual degrees.	Yale School of Management, National University of Singapore Business School, IE Business School, University of Ghana Business School
Association of Pacific Rim Universities (APRU)	Connecting leading research universities of the Asia-Pacific region to address common challenges and	While geographically focused, its impact and membership from a vast region give it global significance. Focus on research, education, and	University of California, Berkeley; Peking University; University of Tokyo; Australian National University

	opportunities.	policy advocacy.	
Consortium of Universities for Global Health (CUGH)	Supporting academic institutions and partners to improve the wellbeing of people and the planet through education, research, service, and advocacy in global health.	Specific focus on global health, diverse membership including medical schools and public health programs.	Universities globally with strong global health initiatives.
Open Society University Network (OSUN)	Integrating learning and knowledge to address global challenges, focusing on open societies, human rights, and social justice.	Emphasis on interdisciplinary teaching, research, and public engagement, particularly in challenging contexts.	Central European University, Bard College, American University of Central Asia

Core Objectives of Global University Networks

Global University Networks (GUNs) are not merely collections of universities; they are strategically formed alliances driven by specific, interconnected objectives designed to leverage collective strengths for greater impact in the global higher education landscape (Deredzai & Goronga, 2025). While the precise aims might vary slightly between networks depending on their focus (e.g., research-intensive, specific disciplines, or regional impact), several core objectives are common across most prominent GUNs:

a. Enhance Academic Excellence and Quality:

   i. Elevate Teaching and Learning: By sharing best practices, innovative pedagogies, and diverse curricula, GUNs aim to enrich the educational experience for students. This includes facilitating joint degree programmes, credit transfers, and

blended learning initiatives that expose students to varied academic traditions and global perspectives.

ii. Promote Cutting-Edge Research: A primary objective is to foster interdisciplinary and international collaborative research. By pooling expertise, resources, and infrastructure, GUNs enable members to tackle complex global challenges that require multidisciplinary approaches, leading to groundbreaking discoveries and solutions.

iii. Facilitate Knowledge Exchange: Networks provide platforms for faculty, researchers, and students to exchange ideas, methodologies, and findings, accelerating the dissemination of knowledge and fostering a global intellectual community.

b. Foster Global Citizenship and Competency:

i. Develop Globally Minded Graduates: GUNs strive to cultivate graduates who possess not only specialised knowledge but also strong intercultural communication skills, adaptability, and a deep understanding of global issues. This is often achieved through student mobility programmes, collaborative virtual projects, and curricula with a global focus.

ii. Promote Cultural Understanding: By facilitating interaction among students and faculty from diverse backgrounds, GUNs break down cultural barriers, fostering empathy, tolerance, and mutual respect crucial for navigating an interconnected world.

c. Address Global Challenges and Societal Needs:

i. Contribute to Sustainable Development: Many GUNs explicitly align their activities with the United Nations Sustainable Development Goals (SDGs), focusing research, education, and outreach on areas like climate action, global health, poverty reduction, and sustainable cities.

ii. Inform Policy and Practice: By generating robust, evidence-based research and fostering expert dialogue, GUNs aim to influence national and international policy-making and contribute to practical solutions for societal problems.

d. Strengthen Institutional Capacity and Internationalisation:
    i. Build Institutional Capabilities: GUNs can help member universities enhance their own internationalisation strategies, improve administrative efficiency in global partnerships, and develop expertise in managing complex cross-border collaborations.
    ii. Increase Global Visibility and Reputation: Membership in a prestigious GUN can significantly raise a university's international profile, attracting top talent (students and faculty) and opening doors to new funding opportunities and strategic partnerships.
    iii. Leverage Collective Resources: By sharing administrative burdens, negotiating power, and access to specialised facilities, GUNs allow member institutions to achieve economies of scale and pursue ambitions that might be beyond the scope of a single university.
e. Cultivate Future Leaders and Talent:
    i. Nurture Leadership Skills: Many networks include programmes specifically designed to develop leadership capabilities among students, faculty, and administrators, equipping them to lead in a global context.
    ii. Support Early Career Researchers: Providing opportunities for mentorship, networking, and collaborative research for postgraduate students and early career academics is often a key objective, ensuring a pipeline of future global talent.

Key benefits of participation

Participation in Global University Networks (GUNs) offers a multitude of key benefits for member institutions, extending beyond individual academic and research pursuits to encompass broader strategic advantages and societal impact (Marginson, 2022). These benefits reinforce the rationale for universities to engage in such complex, multilateralliances:

1. Enhanced Global Reputation and Visibility: Joining a prestigious GUN significantly elevates an institution's international standing and

visibility. It signals a commitment to global engagement, academic excellence, and collaborative innovation, which can attract top-tier students, faculty, and research funding. This improved reputation can also positively influence international university rankings.

2. Access to Diverse Expertise and Resources: GUNs provide unparalleled access to a vast pool of specialised knowledge, research infrastructure, and diverse academic perspectives from around the world. This allows institutions to tap into expertise they might lack internally, fostering interdisciplinary breakthroughs and enriching both teaching and research endeavors. Members can share access to unique laboratories, specialized databases, and even rare collections.
3. Expanded Research Opportunities and Impact: Collaboration within GUNs enables larger, more ambitious research projects that address complex global challenges (e.g., climate change, global health, food security). By pooling resources and expertise, universities can undertake studies that would be impossible for single institutions, leading to more impactful discoveries and a greater contribution to solving pressing societal problems.
4. Enriched Educational Experience for Students: Students benefit immensely through:
    a. Mobility Programmes: Opportunities for international exchange, study abroad, and joint/dual degree programs broaden their academic horizons, expose them to different teaching styles, and foster cultural competency.
    b. Globally Relevant Curricula: Access to diverse course offerings and instructors from partner institutions, often leading to more globally focused and interdisciplinary learning experiences.
    c. Enhanced Employability: Graduates gain a competitive edge in the global job market due to their international experience, intercultural skills, and expanded professional networks.
5. Professional Development for Faculty and Staff: Faculty members gain opportunities for international collaboration, co-authorship of research, access to new methodologies, and professional networking.

Staff can also benefit from sharing best practices in international education administration, technology, and university management.

6. Increased Funding and Strategic Partnerships: Membership in a GUN can open doors to new funding sources, including international grants and philanthropic initiatives that specifically target collaborative global projects. These networks can also serve as platforms for forging other strategic partnerships with industry, governments, and Non-Government Organisations (NGOs) on a global scale.
7. Capacity Building and Knowledge Transfer: For institutions in developing regions or those aiming to strengthen specific areas, GUNs offer invaluable opportunities for capacity building through mentorship, training programmes, and knowledge transfer from more established partners, helping to raise overall standards and reduce disparities.
8. Influence on Global Policy and Advocacy: By presenting a united front, GUNs can collectively advocate for higher education's role in global policy discussions, influencing international agendas on issues such research funding, educational standards, and sustainable development.

Challenges faced by GUNs

While Global University Networks (GUNs) offer immense benefits, their formation and effective operation are fraught with significant challenges that require careful navigation. These obstacles often stem from the inherent complexities of bringing together diverse institutions across varied geopolitical, economic, and academic landscapes (Knoth et al., 2023).

Here are some of the key challenges faced by Global University Networks:

1. Administrative and Bureaucratic Hurdles:
    a. Differing Academic Calendars and Structures: Reconciling varying academic years, semester systems, credit transfer mechanisms, and grading standards across institutions can be a major logistical challenge or student and faculty mobility, as well as joint programme development.

b. Legal and Regulatory Discrepancies: Navigating diverse national laws, accreditation requirements, intellectual property rights, data privacy regulations (e.g., GDPR), and visa policies can be complex, time-consuming, and costly.

c. Institutional Autonomy vs. Network Alignment: Universities value their autonomy, and convincing them to align their internal strategies, resource allocation, and decision-making processes with network-wide goals can be a delicate balancing act.

2. Technological Disparities and Infrastructure Limitations:

   a. Unequal Access to Technology: Not all member institutions, especially those in developing regions, have access to robust internet infrastructure, up-to-date software, or reliable power supply. This digital divide can hinder seamless virtual collaboration, online learning initiatives, and data sharing.

   b. Interoperability Issues: Integrating different learning management systems (LMS), research platforms, and administrative software across institutions can be technically challenging and require significant investment.

   c. Cybersecurity Concerns: Sharing sensitive data and operating interconnected systems expose the network to various cyber threats. Protecting intellectual property, student records, and research data across multiple jurisdictions with varying security protocols is a significant challenge.

3. Financial Constraints and Sustainability:

   a. Funding Models: Securing sustainable funding for network-wide activities, administrative overheads, and joint projects can be difficult, as traditional national funding mechanisms often prioritize domestic initiatives.

   b. Cost Sharing: Ensuring equitable contributions and managing financial flows across different countries with varying economic capacities can lead to tensions.

c. Return on Investment (ROI) Justification: Demonstrating clear and measurable benefits to secure continued institutional commitment and investment can be challenging, particularly in the short term.

4. Cultural and Communication Barriers:

   a. Language Differences: While English often serves as a lingua franca, nuances can be lost, and significant portions of the academic community may not be fully proficient, leading to communication breakdowns.

   b. Varying Academic Cultures: Differences in pedagogical approaches, research ethics, hierarchical structures, and communication styles can lead to misunderstandings and friction.

   c. Time Zone Management: Coordinating meetings, virtual classes, and collaborative projects across multiple time zones can be logistically challenging and lead to participant fatigue.

5. Equitable Partnership and Power Imbalances:

   a. "Donor-Recipient" Dynamics: Networks involving institutions from highly resourced and less resourced countries can inadvertently perpetuate power imbalances if not carefully managed, potentially leading to an unequal distribution of benefits or decision-making influence.

   b. Recognition and Value: Ensuring that the contributions of all partners, regardless of their size or perceived prestige, are equally valued and recognized is crucial for maintaining genuine collaboration and preventing resentment.

   c. "Brain Drain" Concerns: Some partnerships might inadvertently lead to a "brain drain" if students or faculty from less developed institutions are not adequately supported to return and contribute to their home institutions after international experiences.

6. Lack of Faculty Buy-in and Readiness:

a. Resistance to Change: Faculty members may be hesitant to adopt new collaborative tools, pedagogical approaches, or interdisciplinary methods required for network participation.

b. Workload and Incentives: International collaboration often adds to faculty workload, and insufficient recognition or incentives can limit participation.

c. Training Needs: Faculty may require training in cross-cultural communication, virtual teaching, and collaborative research methodologies.

Strategies for Strengthening Collective Impact

To strengthen the collective impact of Global University Networks (GUNs) and maximize their potential, a series of strategic approaches are essential. These strategies aim to mitigate the challenges faced and amplify the inherent benefits of international academic collaboration (Reed et al., 2022).

Here are key strategies for strengthening collective impact in GUNs:

1. Develop a Clear, Shared Vision and Measurable Goals:

    a. Common Agenda: All participating institutions must commit to a clearly articulated, shared vision of their purpose and a common understanding of the global problems they aim to address. This "common agenda" acts as the guiding star for all network activities.

    b. Shared Measurement: Define specific, measurable, achievable, relevant, and time-bound (SMART) goals and agree on common metrics to track progress. This ensures accountability, allows for continuous learning, and demonstrates tangible impact to all stakeholders and potential funders.

    c. Focus on Systemic Change: Encourage initiatives that aim for systemic change rather than isolated programs. This involves strategies that improve communication across organizations, shift norms, and enhance services system-wide.

2. Foster Robust Governance and Leadership:

a. Flexible and Adaptive Governance: Adopt governance models that are flexible enough to accommodate diverse institutional contexts, yet strong enough to ensure clear decision-making, resource allocation, and accountability. This might involve a dedicated backbone support team or secretariat.

b. Strong Leadership and Champions: Identify and empower visionary leaders within member institutions who can champion the network's mission, secure institutional buy-in, and navigate complex negotiations.

c. Transparent Communication Channels: Establish frequent, structured, and open communication across all levels of the network to build trust, ensure mutual understanding, and maintain common motivation among partners.

3. Invest in Digital Infrastructure and Connectivity:

a. Bridging the Digital Divide: Actively work to address technological disparities among member institutions by facilitating access to reliable internet, shared digital platforms, and necessary software. This might involve joint grant applications for infrastructure development.

b. Interoperable Systems: Prioritise the development or adoption of interoperable digital systems for data exchange, virtual collaboration tools, and online learning platforms to ensure seamless integration and communication.

c. Cybersecurity Protocols: Implement robust and harmonised cybersecurity measures across the network to protect sensitive data, research findings, and intellectual property, building trust among collaborating partners.

4. Promote Equitable and Inclusive Partnerships:

a. Bottom-up Engagement: Encourage organic, bottom-up collaborations initiated by faculty and researchers, alongside top-down strategic directives, to ensure relevance and sustainability.

b. Mutual Benefit and Reciprocity: Design partnerships that ensure clear, reciprocal benefits for all members, regardless of their size, reputation, or economic standing. Actively work to prevent "donor-recipient" dynamics and promote genuine co-creation.

c. Diversity and Inclusion: Actively promote diversity in membership, ensuring representation from various geographic regions, institutional types, and academic disciplines. Foster an inclusive culture where all voices are heard and valued.

5. Cultivate Trust and Shared Culture:

   a. Relationship Building: Invest in opportunities for in-person meetings, workshops, and informal interactions to build strong interpersonal relationships and foster a sense of community among faculty, staff, and students across the network.

   b. Cultural Sensitivity Training: Offer training and resources to help members understand and navigate different academic and national cultures, promoting effective cross-cultural communication and collaboration.

   c. Celebrate Successes: Regularly recognise and celebrate the achievements of the network and its individual members to reinforce positive relationships and maintain momentum.

6. Diversify Funding and Ensure Sustainability:

   a. Innovative Funding Models: Explore diverse funding sources beyond traditional institutional contributions, including joint applications for international grants, philanthropic support, and partnerships with industry or government agencies.

   b. Demonstrate Value Proposition: Continuously articulate and demonstrate the tangible value and Return on Investment (ROI) of network participation to secure long-term institutional commitment and external funding.

Future of Global University Networks

The future of Global University Networks (GUNs) is poised for significant evolution, driven by accelerating technological advancements, shifting global

priorities, and the ongoing demand for more accessible, relevant, and impactful higher education. These networks will likely become even more central to the academic landscape, adapting and innovating to address the complexities of a rapidly changing world.

Here are key trends and characteristics that will define the future of GUNs:

1. Hyper-Digitalization and Hybrid Models as the Norm (Li & Zhang, 2021):
    a. Seamless Virtual Collaboration: Expect a deeper integration of advanced digital platforms, Virtual Reality (VR), and Augmented Reality (AR) to create truly immersive and interactive collaborative learning and research environments. Virtual labs, global online classrooms, and digital conferencing will become even more sophisticated and commonplace, reducing geographical barriers.
    b. AI-Powered Personalisation: Artificial Intelligence will play a transformative role. AI-driven platforms will offer highly personalised learning pathways, adaptive assessments, and intelligent tutoring systems, tailoring education to individual student needs and learning styles across diverse cultural contexts. AI will also streamline administrative tasks, student support, and data analytics for network-wide efficiency.
    c. Digital Credentials and Micro-credentials: The future will see a rise in globally recognised digital credentials and micro-credentials. GUNs will be at the forefront of developing and validating these, allowing students to gain specialised skills and competencies from various network institutions, making qualifications more flexible, accessible, and responsive to industry demands.
2. Increased Focus on Grand Challenges and Interdisciplinary Solutions (Petersen et al., 2022):
    a. SDG-Aligned Research and Education: GUNs will intensify their focus on the United Nations Sustainable Development Goals (SDGs). Collaborative research will be increasingly driven by the need to find global solutions to climate change,

pandemics, poverty, and inequality, fostering deep interdisciplinary work across network members.

b. Impact-Driven Engagement: There will be a greater emphasis on demonstrating tangible societal impact. GUNs will move beyond mere academic outputs to actively engage with policymakers, industries, and communities worldwide to translate research into real-world applications and policy recommendations.

3. Evolving Pedagogy and Skills for the Future Workforce (Michel & Traifeh, 2024):

    a. Skills-Based and Experiential Learning: Education within GUNs will become even more focused on developing critical 21st-century skills like critical thinking, problem-solving, creativity, collaboration, and digital literacy. This will involve more project-based learning, simulations, and real-world experiences, often co-created with industry partners within the network.

    b. Lifelong Learning Ecosystems: GUNs will expand their offerings beyond traditional degree programmes to include continuous professional development and up-skilling opportunities for a diverse global workforce, catering to the need for lifelong learning in a dynamic job market.

4. Strengthened Governance, Equity, and Inclusivity (Kaur & Tham, 2022):

    a. Sophisticated Governance Models: As networks grow in complexity, governance structures will need to become more sophisticated, agile, and equitable. This includes mechanisms for fair resource allocation, shared decision-making and robust conflict resolution among diverse partners.

    b. Addressing Power Imbalances: A critical area of focus will be ensuring genuine equity in partnerships, actively working to prevent "brain drain" and ensuring that institutions from all socio-economic contexts derive mutual benefit and have an equal voice.

c. Localized Global Relevance: While globally connected, GUNs will increasingly emphasize how global knowledge can be adapted and applied to local contexts, respecting diverse cultural norms and local needs.

5. New Funding Models and Industry Integration (Carayannis & Morawska-Jancelewicz, 2022):

    a. Diversified Revenue Streams: GUNs will explore more innovative and diversified funding models, moving beyond traditional government grants and tuition fees. This will include increased philanthropic support, corporate sponsorships for collaborative research, and revenue from joint intellectual property.

    b. Deeper Industry Partnerships: Expect more embedded partnerships with multinational corporations, NGOs, and governmental agencies, leading to co-designed curricula, applied research projects, and direct pathways for student employment within global industries.

Conclusion

Global University Networks (GUNs) have unequivocally emerged as indispensable actors in the 21st-century higher education landscape. Moving beyond traditional bilateral exchanges, these multifaceted alliances leverage collective strengths to tackle grand global challenges, foster academic excellence, and cultivate globally competent citizens. Their core objectives – from enhancing research and teaching quality to promoting cultural understanding and contributing to sustainable development – underscore their vital role in a world demanding collaborative solutions. Despite the inherent complexities and challenges, such as navigating administrative hurdles, bridging technological divides, and ensuring equitable partnerships, the strategic importance of GUNs continues to grow. By prioritising clear shared visions, robust governance, advanced digital infrastructure, and truly inclusive collaboration, these networks can overcome obstacles and amplify their impact.

Looking ahead, the future of GUNs is one of increasing sophistication and integration. They will be characterised by hyper-digitalisation, AI-powered

solutions, and an even sharper focus on interdisciplinary, impact-driven research, aligned with global development goals. As education continues to evolve towards skills-based and lifelong learning models, GUNs will be pivotal in shaping adaptive curricula and fostering global talent. Ultimately, by continually adapting to new realities and deepening their commitment to shared purpose and equity, Global University Networks are poised to remain at the forefront of driving progress, fostering global citizenship, and collectively addressing humanity's most pressing concerns.

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CHAPTER TWENTY-ONE

Globalising Education on Neuropsychiatric Effects of Antibiotics

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Abstract

Antibiotics are well known for fighting infections, but what is often left out of the discussion is their impact on mental health. Their misuse - and even prescribed use - can disrupt the balance of gut bacteria, which plays an important role in how the brain functions. This disruption may cause neurotransmitter imbalances, subsequently leading to several neuropsychiatric disorders. As the world becomes more connected, it is important for healthcare workers to understand these effects. Improving education and encouraging global collaboration will help ensure antibiotics are used more wisely, support mental well-being, and allow exploration of safer alternative ways to treat infections.

Keywords: Globalising Education, Neuropsychiatric, Effects, Antibiotics.

Introduction

Antibiotics are widely recognised for their critical role in combating bacterial infections, revolutionising modern medicine by significantly reducing morbidity and mortality. However, the effects of antibiotics extend beyond their primary role in eradicating pathogens. Although antibiotics are developed to target bacteria, they can have unintended effects on the Central Nervous System (CNS), leading to a variety of neuropsychiatric manifestations. The neuropsychiatric effects of antibiotics encompass a wide spectrum of symptoms, ranging from mild cognitive disturbances and mood changes to more severe outcomes such as anxiety, depression and psychosis.

It is currently believed that antibiotic misuse can induce drug resistance and increase the risk of depression because of the disturbance of intestinal flora (Fan *et al.*, 2022). These effects are often transient and reversible, but they can be distressing for patients and challenging for clinicians to manage. Importantly, these adverse effects are not limited to instances of antibiotic

misuse or overuse. They can occur even when antibiotics are administered at standard therapeutic doses. The case report by Iqbal *et al.* (2022) demonstrated that antibiotics such as Trimethoprim-sulfamethoxazole (TMP-SMX) can induce neuropsychiatric effects, including psychosis, even when prescribed appropriately and not misused. This, again, highlights the need for clinicians to be vigilant about the potential CNS effects during treatment.

These effects should be understood for optimising patient care, particularly in vulnerable populations such as the elderly and those with crucial pre-existing neurological or psychiatric conditions.

Emerging Research on Antibiotics' Unintended Mental Health Effects

Nearly all antibiotic agents have been associated with Central Nervous System effects. These effects can be uncommon, but they can be severe (Skelly *et al.*, 2019). A study highlights how antibiotics can influence brain chemistry and behaviour by disrupting the gut microbiome. This disruption has been linked to an increased risk of depression and anxiety (Dinan & Dinan, 2022), suggesting a complex interplay between gut health and mental health. The gut microbiome, which has long been recognised for its role in digestion and immune function, has been found to also play a significant role in brain health through the gut-brain axis.

Gut Microbiome and Its Role in Health

The gut microbiome is a highly complex and dynamic microbial community, encompassing almost 39 trillion microbial cells, which includes bacteria, viruses, fungi that live in and on us (Kumari *et al*., 2022). A healthy gut with diverse microbes is vital for normal brain functions and emotional behaviours (Suganya & Koo, 2020). Gut bacteria break down fibers from food to produce Short Chain Fatty Acids (SCFAs), which help the gut by reducing inflammation, and supporting brain function. Beneficial bacteria, such as Bifidobacteria, produce tryptophan needed to make serotonin, a neurotransmitter that affects mood and sleep. *Lactobacillus* makes Gamma-Aminobutyric Acid (GABA), promoting calmness (Dinan & Dinan, 2022).

Antibiotics' Impact on the Gut Microbiome

Though antibiotics are highly effective against infections, their broad-spectrum action can unintentionally disrupt the delicate balance of the gut

microbiome. Antibiotics disrupt the delicate balance of the gut microbiome through the following ways:

- **Non-Discriminatory Action:** Antibiotics disrupt the gut microbiome by indiscriminately killing beneficial and harmful bacteria (Zimmermann and Curtis, 2019). Unlike targeted therapies, antibiotics often do not differentiate between "good" and "bad" bacteria. This means they can wipe out beneficial bacteria alongside the harmful ones causing the infection.
- **Shifting the Landscape**: The loss of beneficial bacteria disrupts the overall composition of the gut microbiome. In this disrupted state, this gives room for pathogens like *Clostridioides difficile* to overgrow (Ramírez *et al.*, 2020).
- **Reduced Diversity**: Antibiotic use can reduce gut microbiota species diversity and alter metabolic activity leading to recurrent *Clostridioides difficile* infections (Ramírez *et al*., 2020). Reduced diversity can promote dysbiosis (an imbalance within a community of microorganisms living together — a microbiome), as some bacteria may become overly dominant, leading to an imbalance in the production of metabolites.

How Does the Gut Microbiome Communicate with the Brain?

The Gut-Brain Axis

The gut microbiome is comprised of all the microorganisms in the gut including bacteria, viruses, and fungi and the bi-directional communication between the gut and brain mediated via actions of bacteria is referred to as the "microbiota-gut-brain axis" (Olavarría-Ramírez *et al.*, 2023). The gut microbiome communicates with the brain through a complex network of nerves, hormones, and immune messengers. One of the primary neural routes is the vagus nerve, which transmits signals (neurotransmitters) between the gut and the brain (Ashique *et al.*, 2024).

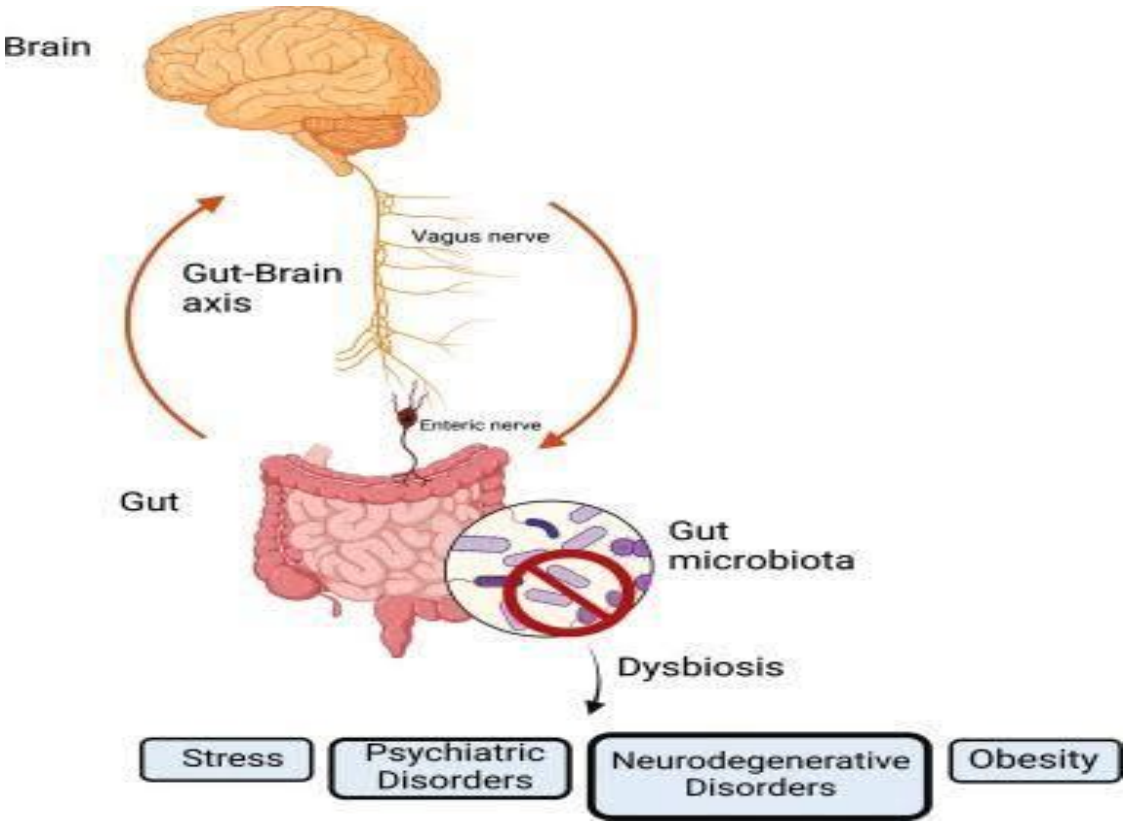


Figure 1: Gut-Brain Axis

Source: (Singh *et al.*, 2024).

Neuropsychiatric Effects Associated With Antibiotics

Anxiety

Anxiety disorders are a group of mental health diagnoses characterised by excessive, persistent, and irrational fear or worry about everyday situations or events. Fluoroquinolones, a class of antibiotics used to treat serious bacterial infections, including respiratory, urinary tract, and skin infections, are associated with psychiatric adverse events such as anxiety (Xie *et al.,* 2024).

Depression

Depression is a common mental disorder with persistent depressed mood and common symptoms like inferiority, pessimism and suicide behaviour (Meng *et al.*, 2022). As a serious mental illness, depression is recognised as a disease associated with the gut microbiota and the brain–gut axis (Wen-Zhi *et al.,*

2020). Dinan and Dinan study in 2022 found that antibiotic exposure is associated with an increased risk of depression. A single course of antibiotics was linked to a higher risk of depression, with penicillins and quinolones. The risk of depression increased with repeated antibiotic use.

Mania

Mania is a mental illness characterised by increased talkativeness, rapid speech, decreased need for sleep, racing thoughts and distractibility (Dailey & Saadabadi, 2023). Meszaros *et al*. (2021) reported a case of antibiotic-induced mania in a 50-year-old man with no prior psychiatric history. The patient initially started treatment with amoxicillin-clavulanic acid for left basal pneumonia and later switched to clarithromycin. Shortly after beginning the antibiotic therapy, the patient developed psychiatric symptoms, including logorrhea (excessive talking), elevated mood, irritability, increased physical activity, and delusions, which were consistent with a manic episode. Upon stopping clarithromycin, the patient's symptoms improved within 12 hours, supporting the diagnosis of a clarithromycin-induced manic episode. However, when amoxicillin-clavulanic acid was reintroduced for the pneumonia, the psychiatric symptoms reappeared. After discontinuing the second antibiotic, the patient was symptom-free approximately one week after. The case highlights the potential for antibiotics such as clarithromycin and amoxicillin-clavulanic acid to induce manic episodes as a rare but serious side effect.

Psychosis

Psychosis is a clinical syndrome associated with impairments in multiple domains including functioning, thought, behaviour, and cognition (Kilciksiz *et al.*, 2020). It is a severe mental disorder characterised by a loss of touch with reality. The most common antibiotics leading to the development of psychosis are penicillin, fluoroquinolones, cephalosporins, Linezolid and anti-tuberculous drugs (Maqsood *et al.*, 2022).

Table 1: Neuropsychiatric Effects Linked to Antibiotic Use

Antibiotic Class	**Neuropsychiatric Effect**	**Reference**
Beta Lactams e.g Penicillin and Cephalosporins	Psychosis,Mania, Depression	**(**Guglielmo, 2021; Meszaros *et al.*, 2021; Lam, 2021; Liu *et al.*, 2022; Maqsood *et al.*, 2022**)**
Macrolides e.g	Mania, Depression	(Lam, 2021; Liu *et al.,* 2022)
Fluoroquinolones e.g	Psychosis, Anxiety, Mania	**(**Guglielmo, 2021; Maqsood *et al.*, 2022; Xie *et al.,* 2024)
Tetracyclines	Depression	
Sulfonamides	Psychosis	(Liu *et al.*, 2022) (Iqbal *et al*., 2022)

Susceptibility Factors

A. Age as a Determinant

Age is a critical factor influencing susceptibility to antibiotic-induced neuropsychiatric effects.

- **Pediatric population**: The developing brain in children is particularly sensitive to external influences. Antibiotic exposure during critical developmental periods may have long-term consequences for brain function and mental health. A study by Slykerman *et al*. (2019) found that children exposed to antibiotics during the first six months of life had significantly lower cognitive and verbal comprehension abilities at

age 11, as well as increased risks of attention-deficit hyperactivity disorder (ADHD), anxiety, and emotional problems after adjusting for confounding factors like breastfeeding.

- **Geriatric population**: Elderly individuals are more likely to experience adverse drug reactions due to age-related physiological changes, including decreased renal and hepatic function, and polypharmacy. The study by Liu *et al*., 2021 suggested that exposure to certain antibiotics, particularly azithromycin, sulfaclozine, tetracyclines, and veterinary antibiotics, may be associated with an increased risk of depression in elderly individuals.
- **Pre-existing Mental Health Conditions**

  Individuals with pre-existing mental health conditions are at heightened risk of experiencing exacerbated symptoms or developing new psychiatric problems after antibiotic use.

Strategies for Mitigating Risks

To mitigate the risks posed by antibiotics on the gut microbiome and the potential neuropsychiatric symptoms that may arise from this disruption, several strategies can be implemented:

Healthcare providers should:

- Administer antibiotics only when necessary.
- Discontinue the offending antibiotic and switch to a safer alternative if neuropsychiatric symptoms arise (Althubyani *et al*., 2024)
- Choose narrow-spectrum antibiotics over broad-spectrum (Avis *et al.,* 2021).

Patients should:

- Take probiotics/prebiotics to restore gut microbiome (Ashique *et al.*, 2024; Yoo *et al.,* 2024).

Prebiotics and probiotics play crucial roles in gut health. Prebiotics are non-digestible fibers that serve as food for beneficial gut bacteria, promoting their growth and activity. Common sources include bananas, onions, garlic, and whole grains. Probiotics, on the other hand, are live microorganisms that provide health benefits when consumed, found in fermented foods like yogurt,

kefir, and sauerkraut. Together, they help maintain a balanced gut microbiota, supporting digestion and overall health. Probiotic supplementation during the perinatal and infant period can restore gut microbiota imbalance, especially with mixtures of *Lactobacillus* and *Bifidobacterium* strains (Navarro-Tapia *et al*., 2020).

Future Prospects

Antibiotic-specific effects: One crucial aspect of future research is to delve deeper into the differential effects of various antibiotic classes on the gut microbiome and neurotransmitter systems i.e development of selective antimicrobials that target harmful bacteria without disrupting the gut microbiome (Avis *et al.*, 2021).

Alternative Antimicrobial Strategies

a. Phage therapy: This involves the use of bacteriophages to fight bacteria (Tamma and Suh, 2021). Phage therapy, the therapeutic use of bacteriophages to combat bacterial infections, is gaining increasing attention as a promising alternative to traditional antibiotics. Bacteriophages are viruses that specifically infect bacteria, offering the potential for high specificity and minimal impact on the microbiome.

b. Host-Directed therapy: Host-directed therapies represent another promising approach to combating bacterial infections while minimising the impact on the microbiome. The goal of host-directed treatments is to strengthen the immune system of the host, and improve the host's capacity to recognise and react to infections (Gholap *et al.*, 2024). Instead of directly killing bacteria, these strategies focus on bolstering the host's immune response, enabling the body to fight off the infection more effectively.

c. Natural products: Natural antimicrobial compounds are the best alternative for controlling bacterial infections and reducing drug resistance due to their lack of severe side effects, low cost of production, and biocompatibility (Nourbakhsh *et al.*, 2021). Exploring plant-derived compounds and other natural products with antimicrobial properties could lead to the discovery of novel agents with minimal side effects. (Nourbakhsh *et al.*, 2021).

Conclusion

Antibiotics are essential for treating bacterial infections, but their unintended effects on the gut microbiome and brain health cannot be ignored. Disrupting beneficial gut bacteria can reduce neurotransmitter production and short-chain fatty acids, potentially leading to mental health issues. Understanding the gut-brain connection allows for better patient care, especially for vulnerable populations like children, the elderly, and individuals with pre-existing conditions. To minimise risks, monitored antibiotic use, probiotic support, and further research are crucial.

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CHAPTER TWENTY-TWO

Influence of Income Replacement on Management of Chronic Diseases among Retirees in Ilorin South Local Government, Kwara State

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Abstract

The study investigated the influence of income replacement on the management of chronic diseases among retirees in Ilorin South local government. Six (6) research questions were raised, and six (6) research hypotheses were formulated. A survey research design was adopted, and the population for the study included all the retirees in Ilorin South Local Government Area of Kwara State. The study adopted stratified and purposive sampling techniques to select Ilorin South from the sixteen (16) local governments in Kwara state. Three (3) wards were selected from the local government using a purposive sampling technique, and two hundred (200) respondents were selected from these wards. The Income Replacement and Chronic Diseases Management Questionnaire and scorecard (IRCDMQ) was the instrument used for data collection. The research questions were analysed using frequencies, percentages, means, and standard deviations. The hypothesis was tested with a t-test and linear regression at a 0.05 level of significance, and data visualisation was done using ggplot, gtsummary, stargazer packages, and LaTeX. The findings revealed most of the respondents were female, aged 65 – 69 years old, earning below ₦81,000-₦150,000, which is equivalent to $120; and the most common disease among the respondents was arthritis. The hypothesis revealed a significant relationship between post-retirement income and retirees' perception of health management ($p<0.05$), indicating that each additional decrease in post-retirement income is associated with a 0.09081 decrease in the chronic disease management score. Although the study revealed no relationship between post-retirement income and the number of reported diseases, likewise, the differences in pre- and post-retirement income do not influence the number of

reported diseases. Therefore, it is concluded that low-income replacement affects the management of chronic diseases. The researchers recommended that senior citizens, who have served the nation for 35 years or more, should be compensated for their sacrifices during their service years.

Keywords: Chronic disease management, Retirement, Retirees, Income replacement.

Introduction

Disease is the abnormal functioning of an organism (Adalberto & Edwin, 2018). It is a state of physical and anatomical abnormality or disorder that affects the normal functionality of an organism/human. (Howard and Bernell (2016) reported that chronic is commonly used when the root cause of a particular disease lasts for more than three months. Therefore, chronic disease is a physical or anatomical abnormality that last one year or more, limiting daily activities and requiring maximum medical attention and management (Sebelius & Thompson, 2019). Morbidity information of a particular population enables continuous evaluation of the effectiveness of a specific healthcare system or the success of the health policy implemented. Poor management of diseases can lead to multimorbidity, which is a condition of multiple diseases (Skou *et al,* 2022). Nigeria has some of the lowest quality health care in Africa and the world at large as the healthcare system is underdeveloped and lacks modern health equipment and facilities. These challenges have been attributed to poor infrastructure, low government budget, poor staff welfare, and high emigration of healthcare workers (International Trade Administration, 2023).

The income of workers implies the totality of benefits that are given to employees by the employer. This can be salaries, wages, bonuses, and allowances among others for the service offered (Hagedorn, 2023). The income replacement ratio is the percentage of preretirement income received during retirement by an elderly retired person (Schmied, 2023). It is a scheduled amount given to retiree (older person) by the employer during their retirement period, which is the percentage of income received during the pre-retirement period. In most countries, it implies the major monetary benefits received by an employee at the end of a working career. Income replacement is an important criterion embedded under the pension scheme as it ensures the retiree's continuous source of income after disengagement from service.

Retirees, who earn lower income during their pre-retirement days, need a higher replacement during their retirement period as they spend much of their income on food, housing, transportation, and medical care. However, retirees in some states in Nigeria earn as low as ₦500 (30 cents) as monthly pensions. In Kwara state, some retirees earn as low as ₦3000 ($2) monthly (Purcell, 2012, Obiowo, 2024)

Retirement is the stage of total withdrawal from labour force (Dwyer & Hu, 2000). It is accompanied by a reduction in the physiological and psychological commitment of workers (Wang, 2013, Wang & Shi, 2014; Wang & Shultz, 2010). It is a later career development stage in life during which adults continue to grow to pursue different interests. The different types of retirement include phased retirement, deferred retirement, disability retirement, early retirement, and voluntary retirement. This study focused on voluntary retirement. Voluntary retirement is the most common type of retirement and it is primarily based on age or number of years of service. Retirees are paid a lump sum by the government or the employer upon final exit from service as provided by the Retirement Act of a nation. In Nigeria, the traditional retirement age is 65, (though it moved from 55 years to 60 years before now) (Patrick, 2023). Even though the retirement age also varies for some professional workers, retirement usually takes place in older adulthood. Retirees face numerous health challenges, and this is attributed to the diminishing state of physiological and anatomical function of the human body system at this stage of life (Akintunde *et al*, 2021).

Statement of the Problem

Despite the vulnerability of older retirees to chronic diseases, retirees in Nigeria are saddled with the challenge of low-income replacement and poor health challenges among retirees. The National Union of Pensioners reported that some retirees earn as low as N500 (30 cent) pension monthly. Thus, it is observed that lower income among the retirees poses a challenge for managing chronic health conditions. Therefore, this study sought to evaluate the influence of retiree's income replacement on the management of chronic diseases among retirees in Ilorin South Local Government

Objectives of the Study

The study's main objective was to evaluate the influence of income replacement on chronic disease management morbidity management among

retirees in Ilorin South Local Government Area of Kwara State. The specific objectives of the study were to:

1. describe the socio-demographic characteristics of the respondent;
2. evaluate the differences in pre-retirement and post-retirement income among retirees in Ilorin South Local Government Area of Kwara State;
3. examine the relationship between post-retirement income and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara State;
4. determine the relationship between the number of reported diseases and the intensity of the diseases among retirees in Ilorin South Local Government Area of Kwara State;
5. determine the relationship between post-retirement income and retiree's perception on health management in Ilorin South Local Government Area of Kwara State;
6. evaluate the relationship between pre-retirement and post-retirement income differences and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara; and
7. evaluate the relationship between pre-retirement and post-retirement income differences and the intensity of diseases among retirees in Ilorin South Local Government Area of Kwara State.

Hypothesis

1. There is a significant difference in the pre-retirement and post-retirement income among the retirees in Ilorin South Local Government Area of Kwara State.
2. There is a significant relationship between post-retirement income and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara State.
3. There is a significant relationship between the number of reported diseases and intensity of diseases among retirees in Ilorin South Local Government Area of Kwara State.
4. There is a significant relationship between post-retirement income and retiree's perception on health management among retirees in Ilorin South

Local Government Area of Kwara.

5. There is a significant relationship between pre-retirement and post-retirement income differences and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara State.
6. There is a significant relationship between pre-retirement and post-retirement income differences and intensity of the diseases among retirees in Ilorin South Local Government Area of Kwara State.

Method

The study population comprised elderly persons in the Ilorin South Local Government Area of Kwara State, and the target population consisted of retired elderly persons from age 65 to 85 and above in selected wards of Ilorin South Local Government Area of Kwara State. A stratified and purposive sampling technique were adopted for this study. The first stage involved stratifying the state into 16 local government areas, and the second stage involved purposively selecting the Ilorin South Local Government Area. The third stage involved a homogeneous purposive sampling technique to choose three wards namely Akanbi IV, Akanbi V, and Balogun Fulani I from the eleven wards in the LGA, and the last stage involved the adoption of a snowball purposive sampling technique to select 200 retired elderly persons with the assistance of the chairman of the Ilorin South Retiree Association.

A well-structured questionnaire titled "Income Replacement and Chronic Diseases Management Questionnaire and Score-card (IRCDMQ)" was used to collect data. The researcher developed the questionnaire based on the research objectives and research hypotheses that related to chronic diseases. It was segmented into A, B, and C sections. Section A contained the socio-demographic details of the respondent and was designed based on the respondent's features. Section B part of the questionnaire focused on the management of chronic diseases of the respondent, specifically addressing common chronic conditions that affect retirees, such as heart disease, diabetes, arthritis, hypertension, chronic respiratory disease, cancer, depression, and anxiety. The severity of these conditions was measured using a visual analogue scale (VAS) for pain and the Patient Health Score Card (PHSC-4), which allowed respondents to rate the intensity of their conditions based on symptoms, and interference of the disease with the respondent's daily activities. Section C part of the questionnaire focused on the retirees'

perception of their health management during the pre-retirement and retirement period and this was done using a 4 points Likert scale to measure the perception level of the retirees on their health management based on their pre-retirement and retirement income respectively. The average mean was set at 2.50. By this, a mean rating of an item by the respondents equal to or above 2.50 was taken as agreed while less than 2.50 was taken as disagreed. An expert at the Department of Home Economics and Food Science, University of Ilorin Kwara State, Nigeria, validated the questionnaire.

Data were analysed using descriptive, and inferential statistics such as frequencies and percentages. Hypothesis one was tested using a paired sample t-test, while hypotheses two, three, four, five, and six were tested using a regression-based analysis. All null hypotheses were tested at a 0.05 level of significance, and descriptive, inferential statistics and figures were performed and created with R version 4.4.1, and R studio version 2024.4.2.0. Data visualization was done using base R studio statically application base r, ggplot package, gt summary package, stargazer package and latex.

Results

Table 1: Analysis of demographic characteristics of the respondents

Variables		Frequency	Percent%
Gender	Male	52	26
	Female	148	74
Age (in Years)	65-69	124	62
	70-74	40	20
	75-79	16	8
	80-84	16	8
	85 and above	3	2
Marital Status	Married	181	90
	Single	--	--
	Separated	4	2
	Divorced	6	3

	Widow	9	4
Level of education	Primary Education	5	2
	Secondary Education	35	18
	Bachelor's degree	106	53
	Master's degree	29	15
	PhD	25	12

Source: Field Survey (2024)

Table 1 represents the analysis of the demographic characteristics of the respondents, and the following details were revealed: About (26% (n = 52) of the respondents were male, 74% (n = 148) of the respondents were female; most of the respondents were between age 65 - 69 years old with 62% (n = 124). The marital status of the respondents showed that (about 90% (n = 181) were married. The data of the respondents based on level of education showed that (about 53% (n = 106) had bachelor's degrees. This indicated that a higher number of the respondents were female, most respondents were married, and the majority of the respondents were fresh retirees who were between 65 – 69 years of age.

Table 2: Analysis of Pre-retirement income and retirement income of the retirees

SN	Variable	Income in Naira	Frequency	Percent%
1	Pre-retirement income in (Naira)	Less than ₦50,000	7	4
		₦51,000 - ₦80,000	19	10
		₦81,000- ₦150,000	12	6
		₦151,000- ₦200,000	60	30
		₦201,000- ₦300,000	67	34
		₦301,000- ₦400,000	28	14
		₦401,000 – ₦600,000	7	4

		₦601,000 and Above	--	--
2	Post-retirement Income in (Naira)	Less than ₦50,000	47	24
		₦51,000 - ₦80,000	5	2
		₦81,000- ₦150,000	67	34
		₦151,000- ₦200,000	46	23
		₦201,000- ₦300,000	35	18
		₦301,000- ₦400,000	--	--
		₦401,000 – ₦600,000	--	--
		₦601,000 and Above	--	--

Source: Field Survey (2024)

Table 2 represents the pre-retirement income and retirement income of the respondents. It is based on the pre-retirement income of the respondent majority earning ₦151,000 - ₦200,000,

₦201,000 - ₦300,000 at 30% (n = 60) and 34% (n = 67) and based on the post-retirement income majority earning ₦81,000 - ₦150,000 at 67 (n = 34). This indicates that a majority of the retirees earned below $120 United States dollars monthly during retirement.

Table 3: Analysis of the health condition of the respondents

Arthritis	1	57	29
Hypertension	1	25	13
Arthritis, Hypertension	2	20	10
Depression	1	13	7
Diabetes, Heart disease	2	13	7
Cancer, Anxiety	2	12	6
Hypertension, Arthritis	2	9	5

Chronic respiratory disease	2	9	5
Diabetes	1	8	4
Arthritis, Depression, Hypertension	3	6	3
Diabetes, Anxiety, Hypertension	3	5	3
Depression, Heart disease	2	5	3
Diabetes, Depression	2	4	2
Depression, Arthritis	2	3	2
Cancer, Depression	2	3	2
Arthritis, Cancer	2	1	1
Chronic respiratory disease, Arthritis	2	1	1
Depression, Diabetes	2	1	1
Heart disease	1	1	1
Others	--	3	2
NA	--	1	1

Source: Field Survey (2024)

Table 3 represents the health condition of the respondents and it reveals that (about 29% (n = 57) had arthritis; and the more common multimorbidity combinations were arthritis and hypertension 10% (n = 20). This result indicates that arthritis was the common chronic condition experienced by older retirees in Ilorin South Local Government Area of Kwara State.

Table 4: Analysis of the Intensity of the Health Condition of the respondents

	Intensity of the diseases	
Variable	Frequency	Percent %
Minor	41	20
Moderate	53	26

Major	62	31
Severe	44	22

Source: Field Survey (2024)

Table 4 shows the intensity of the diseases of the respondents, and it reveals that 62 (31%) had major, 53 (26%) had moderate, 44 (22%) had severe, and 41 (20%) had minor state of health condition.

Table 5: Frequency, Percentage, Mean Rating, and Standard Deviation on the retiree's perception on the relationship between health management during pre-retirement and post-retirement income

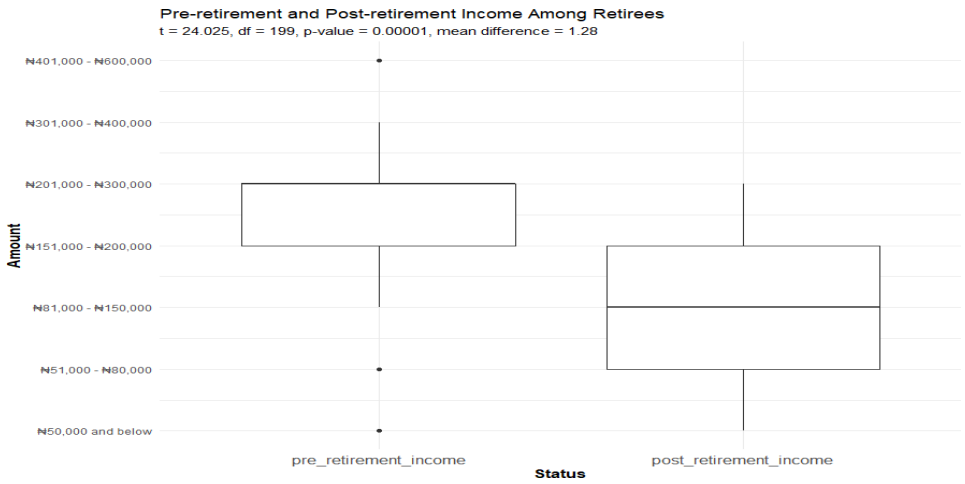
Items	SD f (%)	D f (%)	A f (%)	SA f (%)	Mean $\bar{x}$	Std	Remarks
My financial situation during pre-retirement allows me to effectively manage my health challenge	24 (12)	85 (42)	88 (0)44	03 (02)	2.35	0.71	Disagreed
My financial situation during retirement allows me to effectively manage my health challenge	85 (45)	66 (42)	32 (10)	17 (04)	1.91	0.96	Disagreed

Source: Field Survey (2024) Key SA – Strongly disagreed; D - Disagreed; A Agreed; SA - Strongly agreed; F - Frequency

Table 5 represents the frequency, percentage, mean rating, and standard deviation of the retiree's perception of health management during the pre-retirement and retirement periods. A mean value of 2.35 was obtained for pre-retirement while a mean value of 1.91 was obtained for the retirement income.

The result of the hypothesis

A t-test result on the significant difference between the pre-retirement and post-retirement income among the retirees in Ilorin South Local Government

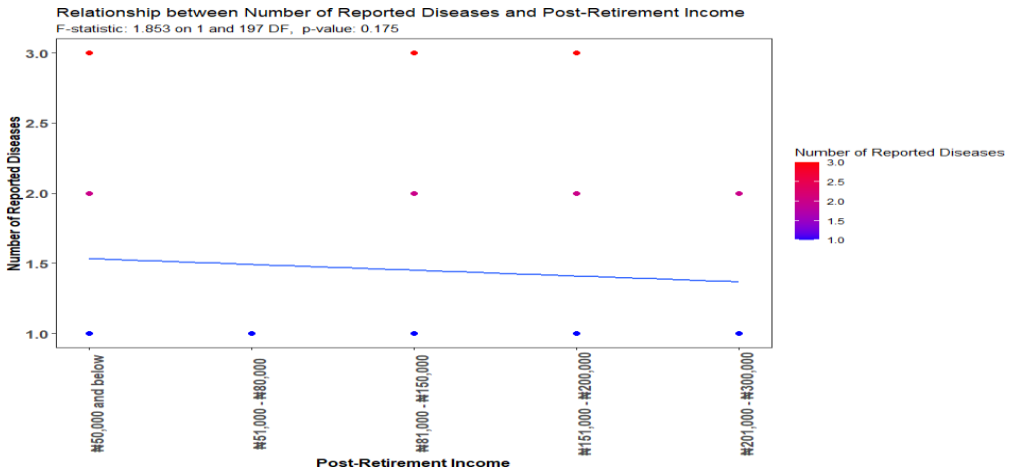


Area of Kwara State

Source: Field Survey (2024)

Figure 1 above reveals the paired t-test analysis to compare the mean of pre-retirement and post-retirement incomes. It shows that a t-value of 24.025 with a degree of freedom of 199, a p-value of 0.00001, and a mean difference of 1.28 was obtained. This indicates a significant difference in pre-retirement and post-retirement incomes of the retirees in Ilorin South Local Government Area of Kwara. Since the p-value of 0.00001 was less than 0.05, with a mean difference of 1.28, it shows that the income replacement is significantly low.

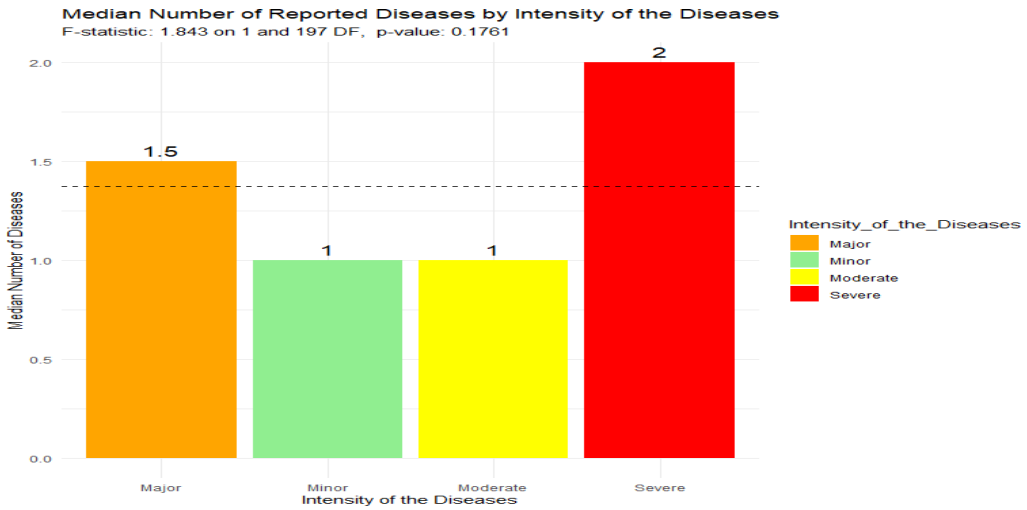
The Relationship between the Post-retirement Income and the Number of Reported Diseases among the Retirees in Ilorin South Local Government Area of Kwara State



Source: Field Survey (2024)

Figure 2 shows the linear regression analysis on the relationship between the post-retirement incomes and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara State. A t-value of -1.36 with a degree of freedom of 197 and a p- value of 0.175 was obtained. This indicates no significant relationship between the retiree's income and the number of reported diseases among retirees in the Ilorin South Local Government Area of Kwara State as the p-value of 0.175 is more than 0.05. Furthermore, the post-retirement income coefficient value of -0.04133 was obtained, and this indicates that for every ₦1 increase in post-retirement income, it will result to a -0.04133 decrease in the number of diseases among retirees.

Relationship between the Number of Reported Diseases and Intensity of Diseases among Retirees in Ilorin South Local Government Area of Kwara State

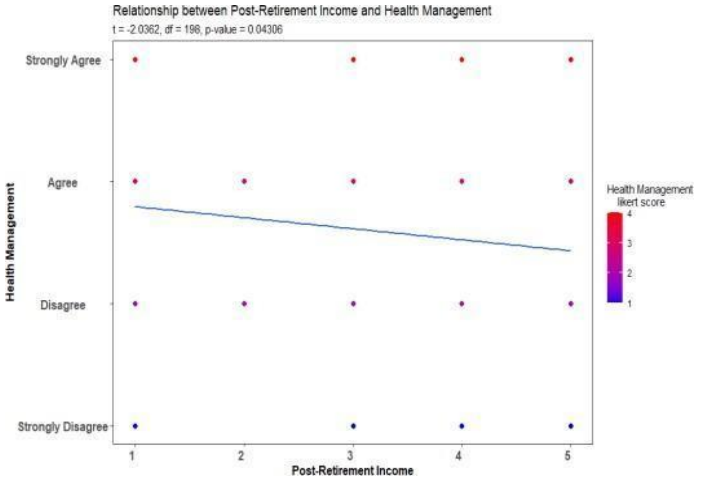


Source: Field Survey (2024)

Figure 3 represents the relationship between the number of reported diseases and intensity among the retirees in Ilorin South Local Government Area of Kwara State. A t-value of

1.358 was obtained with 197 degrees of freedom and a p-value of 0.1761. This indicates no significant relationship between the number of reported diseases and intensity of the diseases among the retirees in Ilorin South Local Government Area of Kwara State, as the p-value of 0.1761 is more than 0.05. The coefficient for the number of reported diseases is 0.171. This suggests that for each additional reported number of diseases, the intensity of the diseases is expected to increase by 0.171.

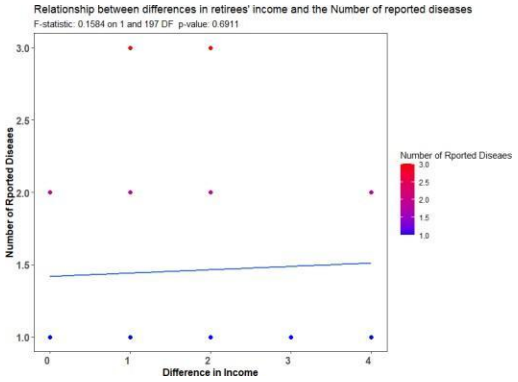
Relationship between the Post-retirement Income and Retiree's Perception on Health Management in Ilorin South Local Government Area of Kwara State



Source: Field Survey (2024)

Figure 4 represents the linear regression on the relationship between post-retirement income and health management among retirees in the Ilorin South Local Government Area of Kwara State. A t-value of -2.0362 was obtained with 198 degrees of freedom and a p-value of 0.04306. This indicates a significant relationship between post-retirement income and health management among retirees in the Ilorin South Local Government Area of Kwara State since the p-value of 0.04306 is less than 0.05. Furthermore, the result revealed that the health management score tends to decrease by 0.09081 for each additional decrease in post-retirement income.

Relationship between Pre-retirement and Post-retirement Income Differences and the Number of Reported Diseases



Source: Field survey 2024

Figure 5 shows the relationship between pre-retirement and post-retirement income differences and the number of reported diseases among retirees in Ilorin South Local Government Area of Kwara. It was revealed that a t-value of 0.398, 197 degrees of freedom, and a p-value of 0.6911 were obtained. This indicates no significant relationship between pre-retirement and post-retirement income differences and the number of reported diseases among the retiree since the p-value of 0.6911 was more than 0.05. It revealed that for every one-unit increase in income difference (pre-retirement and post-retirement income), there is a non-significant 0.023 decrease in the number of reported diseases.

Relationship between Pre-retirement and Post-retirement Income Differences and Intensity of the Diseases among Retirees in Ilorin South Local Government Area of Kwara

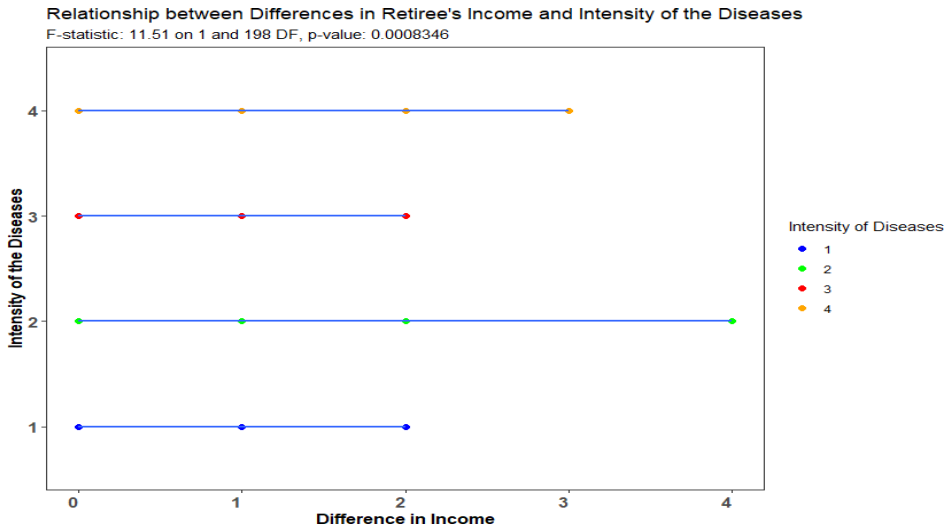


Figure 6 shows the relationship between pre-retirement and post-retirement income differences and the intensity of the diseases among retirees in Ilorin South Local Government Area of Kwara. Fionding revealed that a t-value of 3.393, 198 degrees of freedom, and a p-value of 0.00083 were obtained. This indicates a significant relationship between pre-retirement and post-retirement income differences and the intensity of the diseases among retirees in Ilorin South Local Government Area of Kwara since the p-value of 0.00083 was less than 0.05. Additionally, it was revealed that for every one-unit increase in

income difference (the difference between the pre-retirement and post-retirement income) the intensity of the reported diseases increases by 0.3401 units.

Discussion

The study evaluated the influence of income replacement on chronic disease management among retirees in Ilorin South Local Government Area of Kwars State. Descriptive and inferential statistics were adopted for analysing the data that were collected from the sampled respsondents.

From the socio-demographic characteristic table, the majority of the respondents were female, new cohort, married, and had at least a bachelor's degree qualification.

The analysed data on morbidity and multimorbidity status of the respondents shows that arthritis was the common chronic condition experienced by older retirees in Ilorin South Local Government Area of Kwara State, and the more common multimorbidity combinations were arthritis and hypertension. Anderson and Loeser (2010) reported something similar that increases in age result in osteoarthritis but joint injury increases the intensity.

It was revealed that the financial situation of the respondents in both pre-retirement and post-retirement did not allow proper management of their health. Ugwu and Idemudia (2023) also reported that retirees are often bothered by financial insecurity for their health care management during retirement.

The result of hypothesis 1 revealed a significant difference between the pre-retirement and post-retirement incomes of the retirees with a mean difference of 1.29. This indicates a substantial reduction in the post-retirement income of the retiree. A similar conclusion drawn by Afolabi (2022) was that retirees in Nigeria are experiencing abject poverty, receiving only N4,000-N10,000 ($2-$8) monthly that are unpaid or partly paid, thereby making it difficult for retirees to have proper health management.

The result of hypothesis 2 revealed no relationship between post-retirement income and the number of reported dis eases among the retirees in Ilorin South Local Government Area of Kwara State, and it indicates no connection between low-income earnings among retirees and the level of vulnerability to diseases in older age. Dataphyte (2019) provided contradictory evidence that

revealed the described different findings on the high mortality rate among retirees due to vulnerability to terminal diseases like cancer, and diabetes as a result of low pension income during retirement for proper health management.

The results of hypothesis 3 revealed no significant relationship between the number of reported diseases and the intensity of the diseases among the retirees in Ilorin South Local Government Area of Kwara State. It showed that the number of reported diseases is not connected with the number intensity of the diseases. It was, however, revealed that for each additional reported number of diseases, the intensity of the diseases is expected to increase by 0.171.

The result of hypothesis 4 revealed a relationship between post-retirement income and health management among retirees in the Ilorin South Local Government Area of Kwara State. The result indicated that health management score tends to decrease by 0.09081 for each additional decrease in post-retirement income. Similarly, Ajayi and Ojo (2020) found that a lack of financial stability poses difficulty in retirees' adjustment to health management.

Hypothesis 5 revealed no significant relationship between pre-retirement and post-retirement income differences and the number of reported diseases among retirees. Additionally, for every one-unit increase in income difference (pre-retirement and post-retirement income), there is a non-significant 0.023 increase in the number of reported diseases.

The result of hypothesis 6 revealed a relationship between pre-retirement and post-retirement income differences and the intensity of the diseases among retirees in Ilorin South Local Government Area of Kwara, indicating the influence of income replacement on the well-being of retirees. Gaspar, Rossi, Hone and Dornelles (2021) provided the same evidence that revealed the impact of income inequality and low income on the intensity of diseases.

Conclusion

Based on the findings of this study, it was concluded that low-income replacement (monthly pension) payment of retirees by the government is related to the high susceptibility and management of chronic conditions. Nevertheless, the study revealed no relationship between post-retirement income and the number of reported diseases. Likewise the difference in income does not influence the number of reported diseases. Therefore, the researcher recommended that senior citizens, who had served the nation for 35 years or

more, should be compensated for their sacrifices during service years.

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CHAPTER TWENTY-THREE

Strategies for Promoting Gender Equality in Basic Schools in Nigeria

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Abstract

The discourse on gender equality has increasingly gained traction among education policymakers over the years. This study examined effective strategies for promoting gender equality among basic school pupils in Ibadan metropolis, Oyo state, Nigeria. Descriptive design was employed in this study. The study population consisted of all basic schools in rural communities in Ibadan, Oyo State. A sample of 150 teachers was selected for this study, using probability random sampling techniques. Data gathered in the survey were analysed using percentages, mean, and standard deviation to answer the research questions. The findings revealed a significantly poor perception of gender inequity at the basic school level, with teachers observing high incidences of unequal treatment between boys and girls. Consequently, the study outlined strategies to address these issues, including emphasising education on gender equality, enforcing protective laws, ensuring equal access to leadership roles, and promoting gender-equitable school policies and activities.

Keywords: Gender Equality, Inclusive Education, Education for All, Basic Education.

Introduction

Gender equality is a concept that entails the principle and practice of all individuals having equal access to rights and responsibilities. It can also be described as a situation in which there are no inequalities between males and females in the fulfilment of their rights as human beings. The magnitude and effects of gender awareness have made gender equality highly relevant today, prompting educational centres to prioritise its treatment throughout the school year (Ruiz, 2018). In recognition of this, many organisations and institutions

have adopted essential dates, such as 8th March (International Women's Day) and 25th November (International Day for the Elimination of Violence Against Women), as days of activism and reflection on the movement (Beyene, Chojenta, & Loxton, 2021). Through these foundations, students can learn to reject any form of discrimination and abuse and internalise the values of equality (Abellán, 2014). The Education for All Programme (Al-Jazeera, 2015) has prioritised investing in achieving parity and equality between genders, an idea supported by educational values and the Sustainable Development Goals (Brehim & Boyle, 2018).

Gender equality is Goal number five in the Sustainable Development Goals (SDGs). However, equality should not be treated as merely a democratic principle, but it must be treated as an essential and compulsory goal of educational organisations, schools, public institutions, and institutes (Barrett et al., 2019). Thus, for these values to be effectively transmitted to students, it is essential that teaching be approached carefully in order to ensure absolute equality in the classroom and beyond. Gender equality is an issue of great importance in the formal education system, as equal opportunities for both men and women are essential for achieving parity (Badri, 2015).

Gender equality can be emphasised or minimised in schools (Morawski, 2014). School is where students spend much of their time, and where socialisation occurs. Teachers and classmates are sources of learning about children's gender differences, attitudes, and behaviours. Mägi et al. (2019) stated that education is one of the central institutions that should be investigated to advance gender equality and equal opportunity. It is an effective method for altering society's perceptions and empowering the generation yet unborn. UNESCO (2009) highlighted that there continues to be widespread gender bias in school textbooks and curricula using stereotypical imagery or language.

In schools where formal knowledge is dispensed, stereotypical roles for both sexes are unconsciously taught and learned by the students. Moreover, an online discussion on gender sponsored by UNESCO revealed that teachers significantly impact whether harmful gender stereotypes are upheld or challenged in the classroom. Participants stated that by routinely asking for boys rather than girls or designating classroom activities along traditional lines, like having girls clean, teachers frequently unintentionally promote divides between boys and girls in school. Furthermore, the UNESCO report on Gender and Empowerment Measure (GEM) by Kate Redman indicated that less than

15% of countries include phrases such as "gender empowerment" or "gender-sensitive" in their curricula. While half mention "gender equality," indicating that gender bias is still a severe issue.

The Oxford Committee for Famine Relief (2007) stated that a high-quality education depends on gender equality in the classroom. If schools adopt top-notch gender-equitable curricula and teaching methods, students will be inspired to attend class and enjoy their time. According to Burger (2022), children may suffer if instructors' activities are not intentional and do not come from an environment of equity. One strategy to challenge gender norms is to allow students of different sexes to collaborate, especially in primary school, when children often prefer to choose friends and playmates. To prevent this, teachers should build a mixed-gender group that promotes successful cross-gender teamwork. This strategy enables children to learn new words, exhibit desired behaviours, and contribute to co-creating non-traditional gender roles.

Securing a gender-sensitive classroom does not revolve around the control of the classroom teacher or academic community members. The Scottish Executive Social Research (2006) clarified that parental involvement in gender-related issues contributes to the success of gender initiatives. Schools must emphasise the importance of parental participation since parents are an essential component of all programmes, and are responsible for the success of each project. Parents were frequently explicitly singled out, particularly those fathers who support their child's literacy and reading development. Sellnow (2018) contended that to promote gender equality in the classroom, teachers must involve all students in all activities. By working together in groups of two to five students to achieve objectives, students may begin to respect diverse perspectives and approaches to a topic, case study, or issue.

Even more, the prejudices that men dominate discussions while women speak more gently; or that she is self-effacing while he is a poor listener, can be stopped by including all students. Teachers must get to know every student if they want to engage them. To promote a gender-equal environment, it is also crucial that students are acquainted with one another and address one another by name. For instance, if changing the language of a true-or-false question makes it more straightforward for students to understand, this may be allowed. By putting concepts into practice, teachers can demonstrate to students that they value diverse perspectives and ways of knowing while inspiring them to continue learning throughout their lives. Additionally, Burger's (2022)

research revealed that the educational system promotes traditional ideas on gender stereotypes and traditional gender norms. Most teachers engage in gender-stigmatising behaviours in the classroom and subscribe to gender stereotypes. Teachers deny harbouring any gender preconceptions that they are not aware of or supporting them.

The menace of out-of-school children has posed a significant problem to achieving global education goals. While governmental and non-governmental organisations have tried to rescue the situation through various policies and programmes, such interventions have made little progress. Several empirical studies have examined the possible causes of the persistent increase in the number of out-of-school children. However, none have considered the issue of gender equality and gender-related stereotypes that could make schools unsafe for students' learning. In the light of the foregoing, this study investigated incidents of gender inequality within schools for the purpose of evaluating the effective strategies for promoting gender equality among pupils in Ibadan metropolis, Oyo state.

Gender discourse acknowledges that gender equality encompasses more than simply ensuring an equal number of boys and girls are enrolled in school. However, literature suggests that education policies operate within a very narrow frame, focusing primarily on equal access to education, as measured by the enrollment rates of girls versus boys in schools. This is reflected in policies such as the National Policy Framework for Women's Empowerment and Gender Equality, and the Education White Paper 6 on Inclusive Education, among others. There is a lack of emphasis on ensuring that girls and boys enjoy educational experiences of equal quality after gaining access to school, and there is also a lack of emphasis on developing critical gender consciousness following access to education. This oversight and the limited view of gender equality to only educational access have created another systemic disparity in education. In no small measure, this has complicated the issue of gender inequalities. Beyond creating equal access to education, this study explored effective strategies for promoting gender equality among primary school pupils.

Female and male learners do not have the same experiences in school, and most of the consulted literature agrees with this. Girls are often taken advantage of, and they are socialised into certain gender-specific roles, which has been a major factor in determining the outcome of women's lives for

generations. UNICEF (2012) argued that girls are expected to take on the roles of *homemakers* and 'child-bearers,' which has led to a culture that has reduced the importance put on women's educational attainment. Furthermore, gender inequities filter into the classroom in multiple and interrelated ways: through teachers' attitudes about gender; the curricula in general and specifically, gender and sexual violence against girls; and learner vulnerability to unplanned, parenthood (Chikwiri & Lemmer, 2017). These factors deeply impact students' career aspirations, achievements, and sense of agency. Although gender discrimination can be found in a classroom, a classroom is also a space where it can be dissected, viewed from several angles, and analysed from various perspectives, which could inform other views. Whether or not this happens is one of the factors that was considered in this study for determining effective strategies for promoting gender equality among primary school pupils.

Despite this, reflecting on the need for students to learn to reject any form of discrimination and abuse and internalise the values of equality is especially true when considering gender equality, as seen from both Kaba (2008) and Cretan & Turnock (2008). Kaba's research showed that although African American women have experienced the most severe forms of both racism and gender discrimination, they are still becoming a model minority in terms of college enrollment rates and other life outcomes. On the other hand, Cretan and Turnock (2008) highlighted the case of Roma people in Romania, who struggle to integrate into mainstream society due to their identity, which implies separation from a modernising ethos. Therefore, this points to the need for students to learn about these issues to understand why certain individuals or groups are marginalised, discriminated against, or marked as "the other". Students should also receive education on how to actively fight against such discrimination by internalising values of equality, such as respect for all individuals regardless of race, ethnicity, religion, or gender. Only then will students be able to reject any abuse and discrimination they may encounter truly truly.

Building on this research, literature revealed a lack of equality in classroom processes, school participation, and opportunities. Studies have shown that gender disparities in school activities start early, particularly among 12- or 13-year-olds, and these inequalities can continue into adulthood (Malavé, 2018; Beltrán et al., 2017; Guerrero-Puerta, 2017). Teachers can influence

individuals' students' habits and prevent gender inequality from forming. Addressing this issue requires synthesising the existing literature in an accessible and affordable way, and this study sought to do just that. In line with the foregoing, the study evaluated the effective strategies for promoting gender equality among primary school pupils.

This study aimed to evaluate effective strategies for promoting gender equality among primary and secondary education pupils in Ibadan metropolis, Oyo State. Specifically, the study:

1. investigated gender inequity among basic school pupils in Ibadan metropolis, Oyo State.
2. examined the challenges of gender equality among basic school pupils in Ibadan metropolis, Oyo State.
3. explored the strategies that can be employed to promote gender equality among basic school pupils in Ibadan metropolis, Oyo State.

Methodology

A descriptive survey research design was adopted for this study. The descriptive survey method is often used to collect information from a representative group, and based on this sample, inferences are drawn about the entire population's behaviour. The study population consisted of all teachers at basic schools in the Ibadan metropolis, Oyo State. Multi-stage sampling techniques were employed in this study. At the first stage, stratified sampling was employed to group the basic schools into LGAs. There are five LGAs in Ibadan Metropolis with about 1,576 basic schools. The researchers randomly selected thirty percent of all the basic schools. Random sampling techniques was used to select 473 basic schools and three teachers in each of the sampled schools. A total of 1,419 basic school teachers served as the participants for this study.

A researcher-designed questionnaire titled "Strategies for Promoting Gender Equality in Basic Schools (SPGEBS)" was employed for data collection. The questionnaire was divided into four sections: A, B, C, and D. Section A was used to collect demographic data from the respondents. Section B consisted of items that elicited information on gender inequity among primary school pupils. At the same time, Section C addressed the challenges of achieving gender equality among these pupils. Section D explored the strategies that can

be employed to promote gender equality in schools. The reliability of the instrument was determined by using a test-retest method with an interval of three weeks. The two scores obtained were correlated using the Pearson Product-Moment Correlation Coefficient, and a reliability index of 0.81 was obtained. Mean and rank order were used to answer the research questions one - three.

Data Analysis and Results

Descriptive mean and standard deviation statistics were used to answer research questions 1-3.

Research Question One: What is the extent of gender inequity among basic school pupils in Ibadan metropolis, Oyo State?

To answer this research question, the responses on the incidence of gender inequity among basic school pupils from the questionnaire were collated. The data collected were analysed using the summated mean. A cut-off point 2.50 was used as the baseline for answering the research questions, as the questionnaire was structured with a four-point response type. Therefore, items found with the mean scores equal or above 2.50 were affirmed while items with a mean score below 2.50 were remarked otherwise. The results are summarised in Table 1.

Table 1: Gender Inequity among Basic School Pupils in Ibadan Metropolis, Oyo State

Gender Inequity among Basic School Pupils	Mean	S.D.	Remark
I have on one or two occasions witnessed gender-based discrimination in my school.	3.55	.5344	Affirmed
I feel the male gender faces more inequality in my school	2.74	.5373	Affirmed
Girls in my school are discouraged from participating in sports and physical activities.	2.37	.5812	Disaffirmed
I have experienced or witnessed gender-based bullying in my school.	3.40	.5272	Affirmed

Both boys and girls have equal opportunities to participate in school events.	2.95	.8321	Affirmed
There are gender-specific clubs or groups in my school	2.31	.5649	Disaffirmed
Student have never been excluded from an activity because of their gender.	3.14	.7623	Affirmed
In the past, I have seen students discouraged from pursuing a subject or activity because of their gender.	3.17	.7628	Affirmed
Boys are sometimes discouraged from engaging in artistic and creative activities in my school.	2.88	.8456	Affirmed
I feel the female gender faces more inequality in my school	2.38	.6402	Disaffirmed
Weighted Mean Score	**28.89**		

Table 1 indicates that 150 respondents participated in this study. Responses to items that sought information on the extent of the incidences of gender inequity among basic school pupils in Ibadan metropolis revealed that the majority of the teachers perceived the extent of the incidences of gender inequity among basic school pupils in Ibadan metropolis as high because the benchmark weighted mean score (BWMS) stood at 25.0. Their weighted mean score (WMS) was 28.89, above the benchmark weighted mean score.

Research Question Two: What are the challenges of gender equality among basic school pupils in Ibadan metropolis, Oyo State?

Responses to the challenges of gender equality among basic school pupils from the questionnaire were collated. The data collected were analysed using the summated mean. A cut-off point of 2.50 was used as the baseline for answering the research questions, as the questionnaire was structured with a four-point response type. Therefore, items found with the mean scores equal or above 2.50 were affirmed while item with a mean score below 2.50 was remarked otherwise. The summary of the results is as shown in Table 3.

Table 3: The Challenges of Gender Equality among Basic School Pupils in Ibadan Metropolis, Oyo State

The Challenges of Gender Equality among Basic School Pupils	Mean	S.D.	Remark
Girls and boys are not given equal opportunities to participate in all school activities.	3.60	.550	Affirmed
Some teachers treat students differently based on their gender	3.14	.558	Affirmed
Some school activities promote gender stereotypes that prevent gender equality.	3.63	.544	Disaffirmed
Traditional gender roles and stereotypes affect expectations and opportunities available to students.	3.50	.658	Affirmed
School-related violence can disproportionately affect girls and other marginalized groups, creating an unsafe learning environment.	3.72	.514	Affirmed
A lack of awareness and understanding of gender issues among educators and students may perpetuate discrimination and exclusion.	3.50	.586	Disaffirmed
Inadequate facilities, such as separate and safe sanitation facilities for girls, hinder their attendance and participation in school.	2.46	.563	Disaffirmed
Deep-rooted cultural and societal norms influence attitudes towards gender roles, resulting in unequal treatment of boys and girls	2.77	.797	Affirmed

As shown in Table 3, it was affirmed that the challenges of gender equality among basic school pupils are reflected through unequal opportunities of girls and boys to participate in all school activities; teachers treating students

differently based on gender; some school activities promotes gender stereotypes that prevent gender equality; traditional gender roles and stereotypes affects expectations and opportunities available to students; school-related violence can disproportionately affect girls and other marginalized groups, creating an unsafe learning environment; lack of awareness and understanding of gender issues perpetuate discrimination and exclusion; and deep-rooted cultural and societal norms influence attitudes towards gender roles resulting in unequal treatment of boys and girls. However, it was disaffirmed that inadequate facilities, such as separate and safe sanitation facilities, hinder girls' attendance and participation in school.

Research Question Three: What strategies can be employed to promote gender equality among basic school pupils in Ibadan metropolis, Oyo State?

In order to answer this research question, responses on the strategies that can be employed to promote gender equality among basic school pupils from the questionnaire were collated. The data collected were analysed using the summated mean. A cut-off point of 2.50 was used as the baseline for answering the research questions since the questionnaire was structured in a four-point response type. Therefore, items found with the mean scores equal or above 2.50 were affirmed while item with mean score below 2.50 was remarked otherwise. The summary of the results is as shown in table 4.

Table 4: Strategies that can be employed to Promote Gender Equality among Basic School Pupils in Ibadan Metropolis, Oyo State

Strategies that can be employed to Promote Gender Equality among Basic School Pupils	Mean	S.D.	Remark
Educate boys and girls about gender equality and the importance of equal rights through the curriculum.	3.62	.547	Affirmed
Schools should enforce laws that promote gender equality and protect against gender-based discrimination and violence.	3.62	.624	Affirmed

Give equal access to both genders to participate in school students' leadership positions.	3.65	.481	Affirmed
Men and boys should be encouraged to be allies in promoting gender equality and to challenge harmful gender norms.	3.74	.444	Affirmed
Effective policies that would curb gender inequality in schools should be formulated.	3.71	.520	Affirmed
Sporting activities that promote gender equality should be encouraged.	3.60	.550	Affirmed
Sensitive cultural norms that perpetuate gender inequality in school should be tackled.	3.54	.558	Affirmed

As shown in Table 4, it was affirmed that the strategies that can be employed to promote gender equality among basic school pupils include to educate students about gender equality and the importance of equal rights through curriculum teaching, enforce laws that promote gender equality and protect against gender-based discrimination and violence, give equal access to both gender to participate in school students' leadership positions, boys and men should be encourage to be allies in promoting gender equality and to challenge harmful gender norms, effective policies that would curb gender inequality in schools should be formulated, sporting activities that promote gender equality should be encouraged and sensitive cultural norms that perpetuate gender inequality in school should be tackled.

Discussion

Findings from this study revealed that most teachers perceived the extent of gender inequity among basic school pupils in Ibadan metropolis to be high. A majority of the respondents revealed that they had witnessed one or two occasions of gender-based discrimination in their school, felt that the male gender faces more inequality in my school, experienced or witnessed gender-based bullying in their schools, seen students discouraged from pursuing a subject or activity because of their gender, and that boys are sometime

discouraged from engaging in artistic and creative activities in my school. This findings supported Leach and Machakanja's (2020) study which examined the abuse of junior secondary school girls by older boys, teachers and 'sugar daddies' in Zimbabwe, Ghana and Malawi, and found that there was a high level of sexual aggression from boys, which went largely unpunished in the schools, and some cases of teachers propositioning girls for sex. This behaviour was largely tolerated and normalised. All three educational systems were characterised by a reluctance to take action against either teachers or pupils. Teachers downplayed or dismissed the suggestion that some teachers had sex with their pupils, although both male and female pupils talked about teachers offering to give girls high grades or gifts in exchange for sex. At the same time, there was reluctance among girls to report incidents for fear of being blamed for having 'invited' the abuse, being ridiculed or victimised (e.g., a male teacher singling a girl out for beating in class because she turned him down, or threatening to fail her in tests and exams).

Another finding of the study revealed that the challenges of gender equality among basic school pupils are reflected through unequal opportunities of girls and boys to participate in all school activities. This include teachers treating students differently based on gender; some school activities promotes gender stereotypes that prevent gender equality; traditional gender roles and stereotypes affects expectations and opportunities available to students; school-related violence can disproportionately affect girls and other marginalised groups, creating an unsafe learning environment; lack of awareness and understanding of gender issues perpetuate discrimination and exclusion; and deep-rooted cultural and societal norms influence attitudes towards gender roles resulting in unequal treatment of boys and girls. However, it was disaffirmed that inadequate facilities, such as separate and safe sanitation facilities, hinder girls' attendance and participation in school. This finding corroborated Adeju's (2019) finding that the challenges of gender equality in schools are systemic and deeply rooted in society's cultural background. According to the author, these challenges and factors can affect the realisation of gender equality if they are not controlled. In unveiling the challenges, Adeju (2019) agreed with USAID (2008), UNICEF and UNGEI (2009), and IIEP (2011) that these challenges include: poverty, prohibitive religious practices and beliefs, traditional social-cultural practices, women's under-representation in key decision-making positions, increased violence against women, and limited infrastructure and amenities.

In addition, the study revealed that the strategies that can be employed to promote gender equality among basic school pupils include to educate students about gender equality and the importance of equal rights through curriculum teaching, enforcing laws that promote gender equality and protect against gender-based discrimination and violence, giving equal access to both gender to participate in school students' leadership positions, boys and men should be encourage to be allies in promoting gender equality and to challenge harmful gender norms, effective policies that would curb gender inequality in schools should be formulated, sporting activities that promote gender equality should be encouraged and sensitive cultural norms that perpetuate gender inequality in school should be tackled. This finding is in tandem with the discoveries by Omotola (2018) that Gender inequality in schools is a widespread barrier to girls' attaining educational equity, which also brings with it many health risks. The authors suggested that addressing power imbalances between men and women is central to preventing gender inequality and violence, and this process must be deeply rooted in schools. Tolani (2019) placed emphasis on the fact that successful efforts to avoid gender inequality must include both boys and girls. The lives of girls/women and boys/men are intimately interwoven, and working only with girls is, at best, only half a solution. Framing the issue in the polarising language of girls versus boys, victims versus perpetrators, only exacerbates an already difficult situation and masks the complexity of the dynamics of gender and power. Working with girls and boys, sometimes together and sometimes separately, depending on the social context, is the only way to implement approaches that can truly reshape the construction of gender roles. This transformative approach is key to long-term success. Adeju (2019) also highlighted that gender inequality and violence have not been systematically confronted in the developing world, but several initiatives have been undertaken. These initiatives reflect a variety of approaches, including curriculum development, youth leadership, teacher training, advocacy, community involvement, and policy development. Larkin (2014) posited that a possible solution to gender inequality and violence against female students in schools is to organise symposiums, workshops, and seminars against the use of violence against female students.

Conclusion

The study examined the effective strategies for promoting gender equality among basic school pupils in Ibadan metropolis, Oyo State, revealing a

significant perception of gender inequity at the basic school level, with teachers observing high incidences of unequal treatment between boys and girls. The challenges that were identified encompassed a broad spectrum of issues, from unequal participation opportunities in school activities to societal norms that perpetuate gender roles and stereotypes. These challenges contribute to an environment that can be discriminatory and unsafe, particularly for girls and marginalised groups. However, the study also outlined a comprehensive range of strategies to address these issues, emphasising the importance of education on gender equality, enforcement of protective laws, equal access to leadership roles, and promoting gender-equitable school policies and activities.

Recommendations

In line with the findings of this study, the following recommendations were proposed to address gender inequity among basic school pupils in Ibadan metropolis. These recommendations aimed to create a more equitable educational environment where students can thrive without the constraints of gender-based inequality.

1. School authorities should implement comprehensive gender sensitivity training for teachers to ensure equitable treatment and opportunities for all students, regardless of gender.
2. Educational institutions should develop and integrate a curriculum that emphasises gender equality and the importance of equal rights, which could help dismantle traditional gender roles and stereotypes.
3. Schools should establish and enforce school policies that actively promote gender equality and protect students from gender-based discrimination and violence.
4. Educational institutions should create inclusive school activities and leadership opportunities that are accessible to all students, encouraging the participation of both girls and boys equally.
5. Teachers should engage boys and men in the conversation about gender equality, empowering them to become allies and advocates for change within their school communities.

6. Schools and educational institutions should promote sports and extracurricular activities that support gender equality, providing a platform for all students to engage and excel.
7. Educational institutions should address and challenge cultural norms and practices within the school environment that perpetuate gender inequality, ensuring a safe and supportive learning space for every student.

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CHAPTER TWENTY-FOUR

Assessment of Maternal Knowledge on Exclusive Breastfeeding and Nutritional Status of Infants (0-6 months) in Ilorin South, Nigeria

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Abstract

The study investigated maternal knowledge of exclusive breastfeeding and the nutritional status of infants (0-6 months) in the Ilorin South Local Government Area, Ilorin, Kwara State. Five research questions were raised, and two null hypotheses were formulated. A descriptive survey research design was adopted for the study, with the population comprising 2,754 lactating mothers from whom two hundred (200) were selected using multistage sampling. A structured questionnaire was used as the instrument for data collection, which had a reliability coefficient of .952. Findings of the study revealed that 172 (86%) of the respondents (3.18) were aware of exclusive breastfeeding; 120 (60%) of the respondents (2.79) practised exclusive breastfeeding; and 118 infants had B.M.I. values below 18.5, indicating that they were undernourished. 140 (70%) of the respondents (2.84) agreed that maternal knowledge on exclusive breastfeeding influenced their willingness and practice of exclusive breastfeeding. There is a significant difference between the nutritional status of exclusively and non-exclusively breastfed infants ($p < 0.05$), and the level of maternal knowledge significantly influences exclusive breastfeeding ($p < 0.05$). The study concluded that a majority of breastfeeding mothers have knowledge of exclusive breastfeeding. It is recommended that lactating mothers practice exclusive breastfeeding.

Keywords: Exclusive breastfeeding, Nutritional status, Maternal knowledge, Infants.

Introduction

Knowledge is the product of information provided and received systematically on a given subject. Information is defined by Olajide (2015) as facts and opinions provided and received in the course of human daily activities. Facts communicated and received on a subject are capable of modifying the knowledge state of an individual. Kadir, (2019) stated that nutritional status can be interpreted as a nutritional health condition of the community, which is very dependent on the level of food consumption needed by the body, the composition of food and its comparison with one another. Nutritional status is a condition driven by dietary intake as well as the use of nutrients digested and absorbed by the diet intake. Nutritional status can be malnutrition, good nutrition and over nutrition (Kemenkes, 2018). Good nutritional status can be the foundation of sound health that will optimise growth and development and reduce morbidity, disability, and death so that it will affect the quality of human resources. Conversely, poor or excessive nutritional status has a bad impact - both short and long term. Children who are mal-nourished will be very potentially affected by the disease. Thus, provision of knowledge for lactating mothers on infants' nutritional status as well as its relationship with exclusive breast feeding practices is necessary if the health growth and development is required among babies (Kadir, 2019). This knowledge can be delivered through different media such as oral, print and non- print resource. It can also be delivered through the use of information and communication technologies such as radio and television stations.

Breast milk is nutritionally composed, digests easily, promotes immunity and enhances healthy growth in infants. Breast milk alone provides all of the nutritional need - both macro and micro nutrients, be it vitamins and minerals. Hence, no other liquid or food is needed (Tahiru *et.al.* 2020). Studies have shown that knowledge of exclusive breastfeeding among the lactating mothers are high while the practice is very low. However, in the past, breast feeding was generally acknowledged across the world among all human group, communities, societies and cultures as the most suitable form of infant feeding, which is based on scientific evidence that support the essential role of breast feeding in the survival, growth, maturation and development of a child (Operto, 2020). However, breast feeding practice is being gradually replaced by artificial body food, but breastfed children have greater chance of survival in the early month than non-breastfed children (Samuel *et al.,* 2020). Breast

feeding plays the fundamental and essential component of the development and child-survival strategy. Breast milk is the first natural food for babies. It provides all the essential energy and nutrients that the infant needs for the first six months of life. It provides major child's nutritional needs during the second half of the first year, and up to one third during the second year of life Sobkoviak *et al.*, (2012).

On the other hand, breast milk is considered as the most complete nutritional source for infants because it contains essential fats, carbohydrates, proteins, and immunological factors needed for infants to thrive and resist infection in the first six (6) month of life (Awano *et al.,* 2010). Breast milk is made up of the necessary nutrients that infants need for healthy growth and development, protecting them from gastrointestinal respiratory infections, obesity, risk of allergies, endocrine diseases, and promotes mental health and psychomotor development (Kramer *et al.,* 2012). Although, it is widely known that breastfeeding is an important step in the reproductive process of women and its practice offers benefits to both mother and child, the offering of the maternal breast to the infant is an unquestionable right of mothers. Most of the available information highlighted the benefits of breast milk for infant, while the effects of breastfeeding on the health of the infant and also to the mother have also been well documented(Del Ciampo *et al*., 2018). According to United Nation Children's Fund, it has been estimated that 1.3 million deaths could be prevented and most of childhood illness can be eliminated each year if babies were exclusively breastfed for the first six months of life. The breast milk contains numerous substances such as water, protein, fat, carbohydrates, vitamins minerals and colostrums, which provide protective antibodies that boost the infant's immune system.

Exclusively breastfeeding can be defined as a practice whereby the infants receive only breast milk and not even water, other liquids, tea, herbal preparations or food during the first six months of life, with the exception of vitamins, minerals supplements or medicine. Breastfeeding is less stressful; it requires no cleaning of plates or bottles, no heating of feeds, no modification of milk. In addition, breast milk is cheap. Exclusive breastfeeding (EBF) for the first six (6) months of life improves the growth, health and survival status of infants (World Health Organisation, 2003); and it is one of the most natural and best forms of preventive medicine (Geneva *et al.,* 1991). Exclusive breastfeeding is the provision of only breast milk as food for an infant without

any other liquid except syrups, which may be medicines or vitamins. Food is important in the life of every human being because it provides energy and nutrients required for activities, growth, repair and prevention of diseases (Olofin, 2016). When an infant is poorly fed, it becomes weak, loses weight and becomes inactive and can be easily attacked by infectious diseases. In 2002, the World Health Organisation and UNICEF adopted the Global Strategy for infant and feeding. The strategy was developed to revitalise world attention to the impact that exclusive breastfeeding practices have on the nutritional status, growth development as well as on the health, and survival of infants. World Health Organization (WHO) recommended exclusive breastfeeding for the first six months of life and continuation of breastfeeding should be adhered to thereafter; or before the introduction of adequate complementary foods for up to two years of age or beyond.

However, inadequate maternal knowledge about exclusive breastfeeding is affecting the practice in different dimensions. Some factors that contribute to the problem of inadequate knowldge include custom, tradition, desire for mothers to maintain their shape, desire for the breast not sagging, working place, family income, mothers health problem and career women. Kramer *et al.,* (2012) postulated that non-exclusively breastfed infants are at higher risk of being exposed to morbidity and mortality. Exclusive breastfeeding creates a rewarding opportunity for interaction between mother, child; and also has a positive impact on the mother's health. Yet, the practice is on the decline (Angadi *et al*., 2015). The consequences of poor infant feeding by not practicing exclusive breastfeeding among mothers is one of the major problem and serious obstacle to health issues affecting infants nutritional status and their health. This study, therefore, explored the level of maternal knowledge and practices of exclusive breastfeeding in order to establish a relationship between exclusive breastfeeding and nutritional status of infants (0-6 months) in Ilorin South Local Government Area of Kwara State.

Objective of the Study

The general objective of the study was to assess maternal knowledge on exclusive breastfeeding and nutritional status of infant (0-6 months) in Ilorin South Local Government Area of Kwara State. The specific objective were to:

1. assess the level of maternal knowledge on exclusive breastfeeding among lactating women in Ilorin South Local Government Area of Kwara State;
2. investigate the extent at which lactating mothers in Ilorin South Local Government of Kwara State practice exclusive breastfeeding;
3. determine the BMI and nutritional status of infants (0-6months) in Ilorin South Local Government Area of Kwara State; and
4. investigate the influence of maternal knowledge on exclusive breastfeeding among lactating women in Ilorin South Local Government Area of Kwara State.

Research Questions

These questions are raised as guidelines for the study

1. What is the level of maternal knowledge on exclusive breastfeeding among lactating women in Ilorin South Local Government Area of Kwara State?
2. What is the level of exclusive breastfeeding practices among lactating mothers in Ilorin South Local Government Area of Kwara State?
3. What are the BMI and nutritional status of infants (0-6months) in Ilorin South South Local Government Area of Kwara State?
4. What is the influence of maternal knowledge on exclusive breastfeeding among lactating women in Ilorin South Local Government Area of Kwara State?

Research hypotheses

The following null hypothesis were formulated to guide the study

1. There is no significance difference in the nutritional status of exclusively and nonexclusively breastfed infants.
2. Maternal nutritional knowledge does not significantly influence exclusive breastfeeding practices among lactating mothers.

Methodology

The study adopted a descriptive survey research design. Descriptive survey method of research is concerned with generalized statistic resulting when data

are obtained from part of a large population and used to generalize (Ekeh, 2003).

The population of this study comprised all the Two Thousand Seven Hundred and Fifty Four (2,754) lactating mothers from two selected hospital in Ilorin South Local Government Area of Kwara State.

Two Hundred (200) lactating mothers were selected from the population, using multistage sampling technique, which represented 7.3% of the population. The multistage sampling techniques was used in the study as follows: Stage1: involved stratifying the state into Local Government. Stage 2: involved selecting one Local Government (Ilorin south) which is the study area. Stage 3: involved using random sampling techniques to select two (2) District/Wards from the Local government. Stage 4: involved using proportionate stratified sampling techniques to determine the number of respondents to be sampled from each District/Ward. The total sample obtained was two hundred (200), which as it has been mentioned, represented 7.3% of the population.

A structured questionnaire tagged Influence of Maternal Knowledge on Exclusive Breastfeeding Questionnaire (IMKEBQ) was used to obtain information from lactating mothers in the Local Government Area. The instrument was developed by the researcher based on the objectives and research questions formulated for the study. The data obtained from the pilot study was subjected to statistical analysis to determine the reliability co-efficient of the instrument. The reliability co-efficient obtained was .952.

Data were collected from respondents by administering the questionnaires. The questionnaires were administered to lactating mothers in the selected hospitals within the Local Government selected for this study with the help of a research assistant. Data collected were subjected to descriptive and inferential analysis, using Statistical package for social sciences (SPSS version 20.0). Research questions were analysed using descriptive statistics (frequency, percentage, mean and standard deviation).The null hypotheses formulated were tested using inferential statistics such as t-test and Pearson Product Moment Correlation (PPMC) at 0.05 levels of significance.

Results and Discussions

Demographic Characteristics of the Respondents

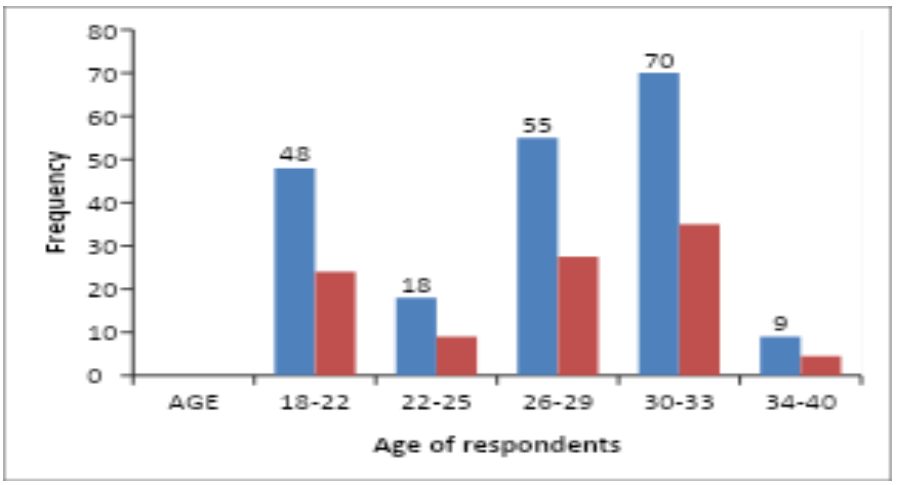


Figure 1: Age of the Respondents

Figured **1** shows that the age range of the respondents. Forty-eight (48) (24.0%) of the respondents were between age range of 18-21 years, 18(9.0%) of the total respondents were between the age range of 22-25, 55 (27.5%) were between the age range of 26-29, 70 (35.0%) were between the age of 30-33 and 9 (4.5.0%) were between the age of 34-40. It can be deduced that a majority of the respondents were between 30-33 years.

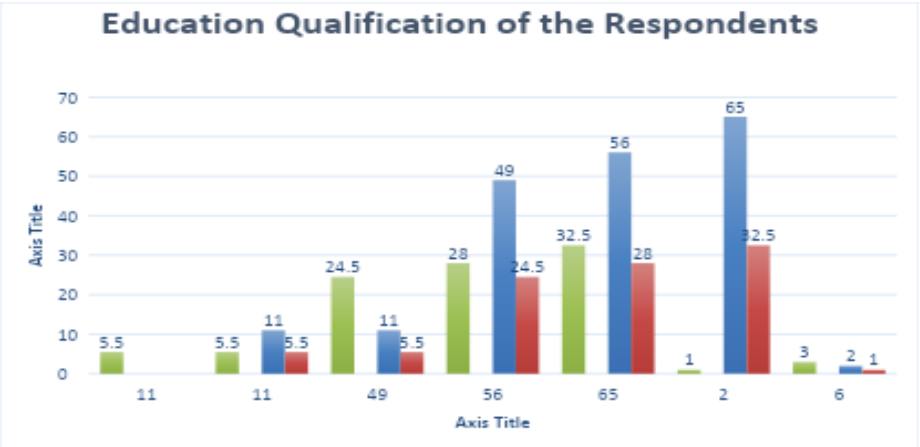


Figure 2: Education Qualification

The education qualification of the respondents revealed that 11 (5.5%) of the lactating parents had no formal education, 11 (5.5%) of the parent were primary school leavers, 49 (24.5%) of the parents had only SSCE, 56 (28%) of the lactating parents were either NCE or OND holders, 65 (32.5%) of the lactating parents were either BSc or HND holders, 2 (1%) of the lactating parents were MSc holders while 6 (3%) of the lactating parents had educational qualification up to Ph.D.

Level of Maternal Knowledge on Exclusive Breastfeeding

Table 1: Level of maternal knowledge on exclusive breastfeeding

Statements	Agreed %	Disagreed %	Mean	S.D	Remark
I am aware of exclusiv breastfeeding	172(86)	28(14)	3.18	0.71	Agreed
I breastfeed my infants exclusively	143(71.5)	57(28.5)	2.99	0.85	Agreed
Every lactating mother understand the term exclusive breastfeeding	84(42)	116(58)	2.49	0.80	Disagreed
I practice exclusive breastfeeding for all my babies	120(60)	80(40)	2.79	0.84	Agreed
Exclusive breastfeeding is important	118(59)	82(41)	2.77	1.04	Agreed
I have heard about exclusive breastfeeding	153(77)	47(23)	2.99	1.00	Agreed
Exclusive breastfeeding improves infant immunity	120(60)	80(40)	2.71	1.03	Agreed
Exclusive breastfeeding allows child spacing	97(48.5)	103(51.5)	2.45	1.02	Disagreed
Exclusive breastfeeding is feeding of infants for about	110(55)	90(45)	2.65	1.08	Agreed

six month

Sources: Field Survey, 2021

The benchmark used for the decision of this result was 2.5. A mean rating of any of the items by the respondents equal or above 2.5 was taken as agreed while the rating below 2.5 was taken as Disagreed.

Table 1 shows the frequency, percentage, mean distribution and standard deviation on the level of maternal knowledge on exclusive breastfeeding in Ilorin South Local Government Area. The Table revealed the level of maternal knowledge of lactating mothers within Ilorin South. However, most of the items in the table had a mean score that was above the benchmark of 2.5, implying a high level of maternal knowledge. More so, 172 (86%) of the respondents with mean score of 3.18 were aware of exclusive breastfeeding, 143 (71.5%) of the respondents with a mean score of 2.99 breast feeded their infants exclusively, 120 (60%) of the respondents with the mean score of 2.79 practiced exclusive breastfeeding for their infants, 120 (60%) with the mean score of 2.71 agreed that exclusive breastfeeding improves infants immunity while 116 (58) with the mean score 2.49 disagreed that every lactating mother understands the term exclusive breastfeeding. Also, 103 (51.5) with the mean score 2.45 disagreed that exclusive breastfeeding allows child's spacing.

This implied that the level of maternal knowledge on exclusive breastfeeding is high 172 (86%) and this agrees with Afolabi (2003) who discovered that the acquisition and utilisation of knowledge, especially in the area of health, helps in preserving and enriching lives. Thus, provision of knowledge or facts on exclusive breastfeeding to lactating mothers is necessary as its application encourages continuity of the natural process of human development which starts in the womb.

Level of Practice of Exclusive Breastfeeding among Lactating Mothers

Table 2: Mean Rating and Standard Deviation of Respondents on the extent at which lactating mothers practice exclusive breastfeeding

Statements	Agreed %	Disagreed %	Mean	Standard Deviation	Remark
All mothers give water fir six months	74(37) 123(61.5	126(63)	2.38	0.77	Disagreed

No liquid aside medicine is giving to infant	)	77(38.5)	278	0.99	Agreed
Food and water should be giving to infants less than six months	118(59)	82(41)	2.58	0.97	Agreed
Most mothers do not practice because they believe it is punishment to infants	69(34.5)	131(65.5)	2.26	0.79	Disagreed
I believe in exclusive breastfeeding	110(55)	90(45)	2.61	0.97	Agreed
I practice exclusive breastfeeding	120(60)	80(40)	2.74	1.05	Agreed

Sources: Field Survey, 2021

Table 2 revealed that a majority of the respondents agreed on the extent to which lactating mothers practice exclusive breastfeeding. However, 123 (61.5%) of the respondents with mean score of 2.78 agreed that no other liquid aside from medicine and vitamin supplement is to be given to infants in the practice of exclusive breastfeeding, 110 (55%) of the respondents with a mean score of 2.61 agreed that they believe in exclusive breastfeeding, 120 (60%) of the respondents with the mean score of 2.74 agreed that they practice exclusive breastfeeding, while 126 (64%) with the mean score 2.38 disagreed that all lactating mothers give water to infants for the first six months. Also, 131 (65.5%) of the respondents with the mean score 2.26 disagreed that most lactating mothers tend not to practice exclusive breastfeeding because they assume it is a form of punishment to infants. This implies that a majority 126 (64%) lactating mothers practiced exclusive breastfeeding. The finding partly agrees with the study of Samuel *et al.*, (2020) who reported that in industrial countries, many working mothers do not breast feed their children due to work force and very short period of maternity leaves.

Table 3: BMI and Nutritional status of infants (0-6 months) in Ilorin South LGA with frequency and their percentage

BMI	Remark	Frequency	Percentage%
Below 18.5	Underweight	118	59
18.5-24.9	Normal	82	41
Above 25	Overweight	--	--
Total		200	100

Source: field survey 2021

Table 3 presents the nutritional status of the infants (0-6 months) in Ilorin South Local Government Area. The nutritional status of the infants was determined from their BMI value calculated from the weight and height of the infants. In calculating the BMI, the weight of the respondents was taken and recorded in kilogram and height was taken with tape rule and record in meter. BMI was calculated by dividing the weights in kilogram by square of the heights in meters. Any value less than 18.5 was rated as underweight; values ranging from 18.5 - 24.9 were rated as normal weight while values ranging from 25.0 - 29.9 were rated as overweight.

However, the result of the findings revealed that 118 (59%) of the infants were underweight, 82(41%) of the infants had normal weight, but none of the infants was overweighed. This shows that a majority (59%) of the infants in Ilorin South Local Government were underweighted.

Influence of Maternal Knowledge on Exclusive Breastfeeding

Table 4: Mean Rating and Standard Deviation of Respondents on the influences of maternal knowledge on exclusive breastfeeding

Sources: Field Survey, 2021

Table 4 shows the frequency, percentage, mean distribution and standard deviation on the influences of maternal knowledge on exclusive breastfeeding. The table reveals that a majority of the respondents agreed on the influences of maternal knowledge on exclusive breastfeeding. However, 140 (70%) of the respondents with mean score of 2.84 agreed that maternal knowledge on exclusive breastfeeding influences practice, 138 (69%) of the respondents with a mean score of 2.90 agreed that lack of knowledge prevents the practice, 122 (61%) of the respondents with the mean score of 2.69 agreed that some mothers do not practice exclusive breastfeeding because they do not want to lose shape, 98 (64%) with the mean score 2.33 disagreed that societal influences as mother's job do not prevents exclusive breastfeeding. This agrees

Statements	Agreed %	Disagreed %	Mean	Standard Deviation	Remark
Maternal knowledg influences practice	140(70)	60(30)	2.84	0.81	Agreed
Lack of knowledg prevents practice	138(69)	62 (31)	2.90	1.04	Agreed
Some mothers don't practice as they don't want to lose shape	122(61)	78(39)	2.69	1.32	Agreed
Societal influences as mother's job do not prevent exclusive breastfeeding	72(36)	98(64)	2.33	0.94	Disagreed

with Tahiru *et.al.* (2020) who revealed that the majority of the mothers, who engaged in some forms of employment, are unable to exclusively breastfeed because facilities at their work places and conditions of work do not support exclusive breast-feeding. In all, maternal knowledge, physical appearance as

well as societal influences affect the practice of exclusive breastfeeding among lactating mothers

Hypotheses Testing

$H0_1$: There is no significance difference in the nutritional status of exclusively and nonexclusively breastfed infants

Table 5: t-test comparing respondents' view nutritional status of exclusively and non-exclusively breastfed infants

V	N	Mean	SD	df	t	Sig.2tailed	Remark
Exclusive		11.34	3.46				
Non-exclusive	200			199	36.125	.000	Rejected
Test value		2.5	0.95				

*Significant at P<0.05

Sources: Field Survey, 2021

Table 5 presents a calculated t-value of 36.125, with a corresponding degree of freedom (df) 36.125 and p-value of .000. The p-value of 0.000 is lesser than the 0.05 alpha levels, indicating that exclusively and non-exclusively breastfed infants are statistically different. Therefore, it is concluded that the null hypothesis, which stated that there is no significant difference between the nutritional statuses of exclusively and non-exclusively breastfed infants, was rejected.

This implies that there is a significant difference between the nutritional status of exclusively and non-exclusively breastfed infants in Ilorin South ($p < 0.05$). This is in consonant with Samuel *et.al.* (2020) who postulated that breastfed children have greater chance of survival in the early month than non-breastfed children, hence their nutritional status.

Maternal nutritional knowledge will not significantly influence exclusive breastfeeding practices among lactating mothers.

Table 6: Pearson Product Moment Correlation(PPMC) on influence of maternal knowledge

on exclusive breastfeeding practices

V	N	Mean	SD	N	r	Sig.	2tailed	Remark
Maternal	200	25.13	6.61					
				200	.621	.000		Rejected
Exclusive	200	10.70	3.26					

*Significant at P<0.05

Source: Field survey, 2021

Table 6 shows a Pearson r of .621** and a p value of .000, testing at an alpha level of 0.05. ($p < 0.05$). The Pearson r of .621** shows a moderate correlation between the maternal knowledge and exclusive breastfeeding. Since the p-value of .000 is lesser than alpha level of 0.05, the null hypothesis, which stated that maternal knowledge will not significantly influence exclusive breastfeeding, was therefore rejected. This implies that level of maternal knowledge significantly influence exclusive breastfeeding. This agrees with Kadir (2019), who stated maternal knowledge influences exclusive breastfeeding practices.

Conclusion

With the finding of the study, it was concluded that a majority of the lactating mothers have knowledge of exclusive breastfeeding, but they do not practice it. Therefore, maternal knowledge of exclusive breastfeeding greatly affects its practice. Significantly, the nutritional status of infants that are exclusively breastfed differs from those that are not.

Recommendations

Based on these findings of the study, the following recommendations are offered:

1. Breastfeeding mothers should practice exclusive breastfeeding- as having just the knowledge is not enough.
2. Proper awareness should be provided on the benefits of exclusive breastfeeding on infants to the lactating mothers infants. Lactating mothers should be encouraged to attend postnatal clinic in order to get more information from health care professionals.
3. Exclusive breastfeeding should be encouraged in our society, especially among working class lactating mothers.

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CHAPTER TWENTY-FIVE

Curriculum Internationalisation in Nigerian Higher Education: A Strategic Approach to Global Practice

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Abstract

The internationalisation of curricula in Nigerian higher education is essential for aligning academic programmes with global standards and equipping graduates with the skills needed to thrive in an interconnected world. However, challenges such as outdated curricula, limited international collaborations, and inadequate policy frameworks hinder this progress. This study examined the significance of curriculum internationalisation, focusing on key elements of internationalisation, such as global partnerships, student and faculty mobility, multilingual education, and the integration of international perspectives into teaching and research. To achieve its objectives, the study proposed a strategic framework that included policy reforms, curriculum development, transnational education programmes, and the adoption of digital and multilingual content. By implementing these strategies, Nigerian universities can enhance their global competitiveness, bridge the gap between local and international educational standards, and produce graduates who are well-equipped for diverse professional environments.

Keywords: Curriculum Internationalisation, Higher Education, Global Practice, Nigerian Universities.

Introduction

The 21st century has ushered in an era of unprecedented global interconnectedness, fundamentally reshaping the landscape of higher education worldwide. Within the dynamic and increasingly integrated global ecosystem that defines contemporary higher education, the internationalisation of curricula for Nigerian universities has transcended the status of a merely desirable aspiration. It has evolved into a critical and non-negotiable strategic imperative that is fundamental to ensuring sustained institutional relevance in a rapidly evolving global academic landscape. It is meant to achieve and maintain academic excellence by aligning with international standards and best

practices. It is also the desirable way of facilitating the production of graduates who are not only academically proficient but also possess the essential knowledge, skills, and global competencies required to effectively navigate, contribute meaningfully, and thrive ethically within a complex and interconnected globalized world. As higher education institutions across the globe actively adapt their academic offerings to respond to the multifaceted demands of globalisation, the ever-expanding knowledge economies, and the escalating prevalence of transnational academic exchanges and collaborations, the Nigerian higher education system must undergo a parallel and equally profound transformation. In this context, curriculum internationalisation is understood as the deliberate, systematic, and ongoing process of integrating international, intercultural, and global dimensions into the very fabric of academic programmes, encompassing their content, pedagogical approaches, assessment methodologies, learning outcomes, and the overall student experience (Knight, 2004).

This study examined the critical significance of curriculum internationalisation within the specific context of Nigerian higher education. It underscored the urgent and compelling need to strategically align local academic content, pedagogical practices, and institutional frameworks with prevailing global standards and best practices. Furthermore, it identified and analysed the key challenges and systemic obstacles that currently impede the widespread and effective implementation of curriculum internationalisation initiatives across Nigerian universities. Building upon this critical analysis, the study culminated in the proposition of a robust, multifaceted, and actionable strategic framework designed to facilitate transformative change within the sector. This framework encompasses the urgent need for comprehensive policy reforms at the national level, the implementation of targeted and sustained curriculum development initiatives designed to foster global pedagogical competence, the establishment and robust support of transnational education programmes that foster cross-border academic collaboration, and the judicious and effective adoption of digital technologies and multilingual learning resources to broaden access and enhance global engagement. Ultimately, this paper argued that the concerted and strategic implementation of these recommendations will not only enhance the global competitiveness and standing of Nigerian universities significantly, but will also play a crucial role in bridging the existing gap between local and international educational standards. This will thereby equip Nigerian graduates with the essential knowledge, skills, and global competencies required to

navigate and contribute meaningfully to diverse and dynamic global professional environments.

The Imperative of Curriculum Internationalisation for Nigerian Higher Education in a Globalised World

The rationale for prioritising the comprehensive internationalisation of curricula within Nigerian higher education is multifaceted and deeply rooted in the evolving dynamics of the global landscape. Firstly, in an era defined by intricately interconnected economies, thriving transnational collaborations across diverse sectors, and the increasing fluidity of global talent, graduates emerging from Nigerian universities must possess a well-developed global mind-set, a deep understanding of intercultural competence, and the demonstrable ability to effectively navigate and contribute within diverse cultural and professional environments. An intentionally internationalised curriculum serves as a powerful catalyst in fostering these crucial attributes by systematically exposing students to a broad spectrum of diverse perspectives, fostering critical engagement with complex global issues, and cultivating essential cross-cultural communication and collaboration skills (Leask, 2015). This, in turn, enhances their adaptability, employability, and capacity to contribute effectively to a globalised workforce.

Secondly, curriculum internationalisation functions as a vital and dynamic mechanism for the continuous enhancement of the quality, relevance, and overall rigour of academic programmes offered by Nigerian universities. By strategically benchmarking against internationally recognised standards of academic excellence and proactively incorporating globally recognised best practices in curriculum design, pedagogical innovation, and assessment methodologies, Nigerian universities can ensure that their academic offerings remain current, intellectually stimulating, and directly aligned with the evolving demands of the global knowledge economy. This strategic alignment is not merely an academic exercise; it is a crucial determinant in significantly improving the employability prospects of Nigerian graduates, both within the domestic job market and in the increasingly competitive international arena (British Council, 2016).

Thirdly, the process of internationalisation can serve as a potent catalyst for stimulating innovation, fostering cutting-edge research, and cultivating a vibrant intellectual environment within Nigerian universities. Increased

exposure to international research trends, the establishment of collaborative research projects with esteemed foreign institutions, and the strategic integration of global case studies and perspectives into research agendas can significantly enrich the academic landscape and foster a robust culture of intellectual inquiry that is capable of addressing both pressing local challenges and complex global issues. Furthermore, a commitment to internationalisation can enhance the attractiveness of Nigerian universities to international students, visiting scholars, and globally recognised faculty, thereby contributing to a more diverse, intellectually stimulating, and globally connected academic community.

Finally, curriculum internationalization plays a pivotal role in significantly enhancing the global standing, international reputation, and overall visibility of Nigerian universities within the global academic community. Institutions that actively and strategically engage in meaningful international collaborations, offer academic programmes that are recognised and respected internationally, and consistently produce graduates who demonstrate global competence and ethical engagement, are far more likely to attract valuable international partnerships, secure competitive international research funding opportunities, and reap increased recognition and prestige within the global higher education landscape (Altbach & Knight, 2007). This enhanced global standing can, in turn, attract further international collaborations and opportunities, creating a virtuous cycle of growth and development.

Challenges Impeding the Advancement of Curriculum Internationalisation in Nigerian Higher Education

Despite the compelling arguments for and the evident benefits of curriculum internationalisation, the effective and widespread implementation of such initiatives within Nigerian higher education continues to be hampered by a constellation of significant and often deeply entrenched challenges:

- **Persistence of Outdated Curricula:** A significant number of academic programmes across Nigerian universities still operate with curricula that have not undergone adequate and timely revisions to reflect the rapid advancements in global knowledge, the transformative impact of emerging technologies, and the evolution of contemporary pedagogical approaches. This inertia can result in graduates who are ill-equipped with the cutting-edge skills, contemporary knowledge, and global

perspectives that are increasingly demanded by the dynamic global marketplace. The lack of regular curriculum reviews, and the often-cumbersome bureaucratic processes involved in curriculum reform, contribute to this stagnation.

- **Limited Engagement in International Collaborations:** The level of sustained, mutually beneficial, and impactful collaboration between Nigerian universities and their counterparts in other parts of the world remains comparatively low. This limited engagement restricts opportunities for collaborative research endeavours, valuable faculty and student exchange programmes that foster intercultural understanding, and the crucial sharing of best practices in innovative curriculum design and effective delivery methodologies. Factors contributing to this include funding limitations, a lack of established networks, and at times, a perceived lack of institutional support for pursuing international partnerships.
- **Inadequate and Fragmented Policy Frameworks:** A well-articulated, strategically focused, and adequately resourced national policy framework that explicitly supports, incentivises, and provides clear guidelines for curriculum internationalisation across all disciplines within Nigerian higher education, is often lacking. This absence can lead to a fragmented, inconsistent, and often ad-hoc approach to internationalisation efforts across different institutions, hindering systemic progress and preventing the development of a cohesive national strategy.
- **Significant Faculty Development Deficiencies:** Many academics within Nigerian universities may lack the specialised training, relevant international exposure, and pedagogical expertise required to effectively integrate diverse international perspectives, complex global issues, and crucial intercultural dimensions into their teaching practices and research endeavours. Opportunities for targeted professional development, specifically focused on the principles and practices of curriculum internationalisation, are often limited in scope, availability, and relevance to the specific needs of Nigerian academics.
- **Language Barriers and Insufficient Emphasis on Multilingualism:** While English serves as the official language of instruction within

Nigerian higher education, the rich linguistic diversity of Nigeria itself, and the increasing global recognition of the strategic importance of multilingualism in fostering effective international communication and collaboration, pose a significant challenge. The relative lack of emphasis on the strategic integration of multilingual education within academic curricula can inadvertently disadvantage Nigerian graduates as they navigate increasingly multilingual and multicultural international settings. Furthermore, the potential of leveraging Nigeria's indigenous languages in fostering intercultural understanding within the national context is often under-explored.

- **Constrained Resource Allocation and Inadequate Infrastructure:** Persistent financial limitations and the presence of inadequate physical and technological infrastructure within many Nigerian universities can severely hinder the effective implementation of meaningful internationalisation initiatives. This includes challenges in developing high-quality internationalised course materials, providing adequate support for student and faculty mobility programmes, and strategically adopting digital learning technologies that can facilitate global connectivity and access to international resources. The lack of consistent funding for internationalisation efforts makes long-term planning and implementation difficult.
- **Challenges in Ensuring Quality Assurance of Internationalised Curricula:** Guaranteeing the academic rigour, relevance, and overall quality of internationalised curricula necessitates the establishment and effective implementation of robust quality assurance mechanisms. Existing quality assurance frameworks within Nigeria may require significant adaptation and enhancement to effectively evaluate the specific international dimensions of academic programmes, ensuring that they meet both national and internationally recognised standards. The lack of specific metrics and evaluation criteria for internationalisation can lead to inconsistent quality and a lack of accountability.

A Comprehensive Strategic Framework for Advancing Curriculum Internationalisation in Nigerian Higher Education

To effectively address the multifaceted challenges outlined above and to foster a deep and meaningful integration of global perspectives into the fabric of Nigerian higher education curricula, a comprehensive, multi-pronged, and strategically aligned framework is urgently required:

1. **Formulation and Implementation of Robust National Policies and Guidelines:** The National Universities Commission (NUC), in collaboration with the Federal Ministry of Education and other relevant stakeholders, must take a proactive and leading role in formulating clear, comprehensive, and strategically focused national policies and overarching guidelines that explicitly prioritise, promote, and provide robust support for curriculum internationalisation across all academic disciplines within Nigerian higher education. These policies should articulate a clear vision for internationalisation, define measurable goals and objectives, and provide a roadmap for implementation at the institutional level. Furthermore, these national policies should incorporate tangible incentives for universities to actively engage in meaningful international collaborations, develop innovative joint degree programmes with international partners, and systematically integrate diverse global perspectives and intercultural competencies into the design and delivery of their curricula. The government, at both federal and state levels, should commit to allocating dedicated and sustainable financial resources to directly support curriculum internationalisation initiatives, including the provision of funding for targeted faculty development programmes, the facilitation of increased student and faculty mobility opportunities, and the development and acquisition of high-quality internationalised learning resources and digital infrastructure.
2. **Strategic and Sustained Investment in Faculty Development for Global Pedagogical Competence:** Nigerian universities must prioritise and invest significantly in the design and delivery of comprehensive and sustained faculty development programmes specifically focused on the principles, practices, and effective implementation of curriculum internationalisation. These programmes should equip academics across all disciplines with the essential skills, relevant knowledge, and

innovative pedagogical approaches. The skills and innovative pedagogical advantage of such programmes enable academics to:

- critically analyse and effectively integrate diverse international case studies, global examples, and comparative perspectives into their teaching and learning materials;
- develop advanced intercultural communication skills and cultivate inclusive and supportive cross-cultural learning environments within their classrooms;
- strategically utilize digital technologies and online platforms to connect with international peers, access global learning resources, and facilitate collaborative online learning experiences for their students; and
- design, develop, and deliver academic courses and programmes that are explicitly framed within a global context and that actively promote the development of global competencies among students.

Universities should actively promote and provide robust support for faculty exchange programmes with international partner institutions, as well as facilitate and fund participation in relevant international conferences, workshops, and seminars focused on curriculum internationalisation and global education. Mentorship programmes, pairing experienced internationalised faculty with those new to the process, can also be highly beneficial.

3. **Cultivating Strategic Global Partnerships and Fostering Transnational Education Initiatives:** Nigerian universities should adopt a proactive and strategic approach to identifying, cultivating, and sustaining meaningful and mutually beneficial partnerships with reputable international universities, leading research institutions, and relevant global organisations. These strategic partnerships should be designed to facilitate a range of collaborative activities, including:

- joint research projects that address global challenges, reciprocal faculty and student exchange programmes that promote intercultural understanding and academic enrichment;

- the collaborative development and delivery of joint degree programmes (transnational education initiatives) that enhance global recognition and provide students with international learning experiences; and
- the effective sharing of best practices in innovative curriculum design, pedagogical methodologies, and quality assurance processes.

Formal Memoranda of Understanding (MOUs) should be meticulously developed with clearly defined objectives, specific responsibilities for each partner institution, and robust mechanisms for ongoing monitoring, regular evaluation, and mutual accountability to ensure the success and sustainability of these collaborations. Exploring opportunities for joint supervision of postgraduate students and the co-publication of research findings can further strengthen these partnerships.

4. **Strategic Integration of Multilingual Education and Intercultural Competence Development:** Recognising the increasing importance of multilingualism in the globalised world and leveraging Nigeria's rich linguistic diversity, universities should strategically explore and implement effective strategies to promote multilingualism and the development of deep intercultural understanding among their students and faculty. This could involve offering a diverse range of elective courses in strategically important international languages, intentionally incorporating multilingual resources and perspectives into core course materials across various disciplines, and actively encouraging student engagement with diverse linguistic and cultural contexts through study abroad programmes, virtual exchange initiatives, and collaborative projects with international students. Universities should also recognise and strategically leverage the rich tapestry of indigenous languages within Nigeria itself as a valuable resource for fostering intercultural understanding and promoting a more inclusive and globally aware learning environment. Integrating cultural exchange activities, international film screenings, and guest lectures from international scholars can further enhance intercultural competence.
5. **Judicious Adoption and Effective Utilization of Digital and Multilingual Learning Content and Platforms:** Nigerian universities must strategically embrace and effectively leverage the transformative potential of digital technologies to significantly enhance curriculum internationalisation efforts. This includes:

investing in the development and robust utilization of user-friendly online learning platforms that provide seamless access to a wide array of high-quality global learning resources and facilitate meaningful connections and collaborative learning opportunities with international peers and experts;

- actively incorporating openly licensed educational resources (OERs) and other freely accessible internationalised learning content into academic curricula, ensuring their quality and relevance to the Nigerian context;
- providing adequate support and resources for the development and effective use of multilingual learning materials and resources that cater to diverse linguistic backgrounds and promote multilingual competence; and
- strategically implementing virtual exchange programmes and collaborative online international learning (COIL) initiatives to provide students with valuable international and intercultural experiences without the significant costs and logistical complexities associated with physical travel.

Ensuring equitable access to technology and providing adequate training for both faculty and students in the use of these digital tools are crucial for successful implementation.

6. **Systematic Curriculum Review and Fostering a Culture of Pedagogical Innovation:** Nigerian universities must establish robust and regular cycles of comprehensive curriculum review, specifically designed to identify strategic opportunities for meaningful internationalisation across all academic programmes. This review process should actively involve input and feedback from a diverse range of stakeholders, including international experts in relevant disciplines, successful alumni with significant international experience, and representatives from industries and organisations operating within the global marketplace. Universities should actively encourage and reward innovative approaches to curriculum design and pedagogical practices that explicitly embed global perspectives, cultivate essential intercultural competencies, and provide students with meaningful opportunities for international engagement and experiential learning. This could include the development of internationally focused case studies, simulations of global challenges, and collaborative projects with international student teams.

7. **Enhancing Opportunities for Meaningful Student and Faculty Mobility:** Nigerian universities should proactively promote and provide

robust support for both inbound and outbound student and faculty mobility programmes, recognising their crucial role in fostering intercultural understanding, academic enrichment, and the development of global networks. This includes providing adequate financial assistance in the form of scholarships and grants, streamlining administrative processes related to visa applications and academic recognition, and establishing clear and transparent credit transfer mechanisms to facilitate seamless academic integration. Concerted efforts should be made to cultivate a welcoming, inclusive, and supportive campus environment for international students and faculty members, providing them with the necessary academic, social, and cultural integration support. Establishing dedicated international student and scholar offices with well-trained staff is essential for providing effective support services.

8. **Strengthening and Adapting Quality Assurance Mechanisms for Internationalised Curricula:** Existing national and institutional quality assurance frameworks must be critically reviewed and strategically adapted to explicitly address and effectively evaluate the international dimensions of academic programmes. This includes developing specific indicators and benchmarks related to the quality and impact of international collaborations, the effective integration of diverse global perspectives into teaching and research activities, and the demonstrated international employability and global competence of graduates. External review processes should incorporate the expertise of individuals with significant international experience in curriculum development, quality assurance in international education, and the assessment of global learning outcomes. Regular monitoring and evaluation of internationalisation initiatives are crucial for ensuring their effectiveness and identifying areas for improvement.

Conclusion

The comprehensive internationalisation of curricula within Nigerian higher education is no longer a peripheral consideration, but a fundamental strategic imperative for universities aspiring to achieve and sustain global relevance, enhance their academic standing, and contribute meaningfully to the sustainable development of Nigeria in an increasingly interconnected world. While the Nigerian higher education sector faces a unique set of persistent

challenges in this endeavour, the potential benefits of cultivating globally competent and ethically engaged graduates, significantly enhancing institutional quality and international reputation, and fostering impactful international collaborations, are undeniably transformative. The comprehensive and multifaceted strategic framework articulated in this paper provides a detailed and actionable roadmap for Nigerian universities to effectively embrace the principles and practices of curriculum internationalization. The framework encompasses robust policy reforms, targeted faculty development, cultivation of strategic transnational partnerships, integration of multilingualism, effective adoption of digital technologies, systematic curriculum innovation, enhancement of mobility opportunities, and strengthening of quality assurance mechanisms, By proactively and strategically implementing these recommendations, the Nigerian higher education system can effectively bridge the existing gap between local and international academic standards, contribute significantly to the global knowledge economy, advancement of research. Most importantly, the recommendations will also empower the Nigerian higher education's graduates with the essential knowledge, sophisticated skills, ethical values, and crucial global competencies necessary to navigate the dynamic global landscape. They will also be able to contribute meaningfully, and thrive ethically, in an increasingly interconnected, complex, and dynamic global landscape, ultimately fostering sustainable development and progress for the nation and its people.

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CHAPTER TWENTY-SIX

The Role of Online Learning in Reducing Carbon Footprints and Enhancing Digital Sustainability in Global Education

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Abstract

Along with the digital transformation of global education, the concept of online learning has attracted more and more attention to the environmental side. This research focused on how online learning can be useful in minimising carbon footprints and promoting digital sustainability. It uses secondary data research methodology to synthesise knowledge that is based on academic publications, institutional reports, and case studies in determining the ecological and operational impact of e-learning. The results indicated that internet-based learning can significantly reduce greenhouse gases as it reduces commuting and decreases the use of physical infrastructure, as well as cutting down on paper. Besides, it helps to have energy-efficient learning environments and protect the reserves. Nevertheless, the problems of digital inequality and the environmental costs of digitisation infrastructures still exist. The research re-emphasises the relevance of inculcating environmentally sensitive and inclusive digital policies in educational systems. With proper behavioural alignment of online learning with global sustainable initiatives in the developing world, the education sector can make a valuable contribution to addressing climate change and advancing sustainability.

Keywords: Online Learning, Digital Sustainability, Carbon Footprint Reduction, E-Learning.

Introduction

Over the last 20 years, the educational landscape has experienced a tremendous change in the educational delivery system, which came as a result of the universality of digital technologies and the global events of the pandemic, including COVID-19. Educational organisations, such as primary schools, colleges, and even universities, have focused on online learning platforms to continue their work and improve access to education and its experience

regarding the evolution of learner needs (Bozkurt et al., 2020). This online shift has not just reshaped the ways of teaching, but it has also brought serious concerns about the sustainability of educational practice in a fast-warming planet. Traditional education has caused adverse effects to the environment historically, which have not been given attention. However, physical campuses use a lot of energy to heat, light, and air condition; emit carbon pollution due to their daily commutes; and use great amounts of paper as well as other consumable materials (Rodriguez & Pons, 2020). It is in this sense that online education provides an attractive alternative, which is more consistent with the aim of environmental sustainability. The conversion to a virtual environment enables institutions to curb the negative impact on the environment as well as save natural resources and help eliminate congestion in the city, particularly in cities with a high concentration of academic organisations (Leal Filho et al., 2022).

Carbon footprint is a general phenomenon that is used to describe the total amount of greenhouse gas (GHG) that is emitted by all of the human activities in terms of carbon dioxide equivalent (CO 2 e). In educational contexts, carbon footprints are the output of different sources: energy used in buildings, emissions during transportation, physical material utilized in teaching and learning, and procurement of the institutions (Roy et al., 2021). Indeed, educational establishments in the industrialised countries are the leading consumers of carbon emissions in the public sector, according to the UK Department for Education (DfE, 2022). Online education can help lower most of these emissions by removing the need to commute every day; by cutting down all the printed documents and lowering the costs of energy associated with infrastructure.

According to a study by Lantada et al. (2020) at Universitat Politica de Catalunya, the format of hybrid learning and remote education can minimise carbon-related emissions of institutions by up to 60%. The same was also reflected in the research done by Mendoza et al. (2019), as they reported the most considerable financial savings on resources that were used in universities implementing online-first techniques.

Although the overall reduction of emissions is one of the main advantages, online learning should be put under scrutiny of overall digital sustainability as well. This idea combines ecological, social and economic sustainability and digital technologies application. It supports the implementation of technology-

based solutions to learning, which should be energy-saving, but also equitable, inclusive, and accessible to various educational situations (Sterling & Thomas, 2021). The concept of digital sustainability is built on the belief that the applied educational technologies must promote long-term sustainable development goals (SDGs), in particular, quality education (SDG 4), climate action (SDG 13), and reduced inequalities (SDG 10) of sustainable development goals (UNESCO, 2021). This vision can be realised through the means of a long-term strategic plan and investments in elements of digital infrastructure, training of teachers, and design of inclusive content. Additionally, since carbon intensity of cloud computing and data centres keeps growing, sustainable design decisions, including the adoption of green hosting services or low-bandwidth platforms, are significantly more essential (Hughes et al., 2022). With the education moving to digital versions, more attention is drawn to its impact on the environment. This paper discusses how online training has reduced carbon impacts besides promoting digital sustainability in international education.

Review of Literature

An increased stream of empirical evidence supports online and blended learning in terms of environmental benefits. E-learning also helps to decrease the distance educated people travel; thus cutting down on the direct and indirect emissions of a traditional education system. As an illustration, Singh and Moe (2022) determined that virtual workshops that replaced face-to-face training programmes led to 80-percent decrease in travel-related emissions in a multinational NGO. Also, schools have an interesting opportunity to reduce their electricity rates substantially if they implement asynchronous online modules, where the server may be used in real-time and classrooms need not be lighted up. Furthermore, using digital textbooks and cloud-based collaborative programmes would decrease the number of printed works and, as such, protect forests and decrease water contamination in the production of paper and ink (Mendoza et al., 2019). These savings, though not easily quantified cumulatively, have an impact mostly when added up among the millions of learners all over the world.

Around the world, all nations have started using national education strategies to include digital sustainability. On the one hand, in Finland, the Ministry of Education and Culture has already launched the policies of school curriculum digitalisation that is highly focused on environmental literacy and embraces

sustainability (Ministry of Education and Culture, Finland, 2021). In a similar vein, the National Education Policy (NEP) 2020 in India refers to digital or online learning as a viable and flexible way to mitigate regional and economic inequalities (Ministry of Education, India, 2020). Digital sustainability has also been scaled at the international level. To cite a recent example, the UNESCO Global Education Coalition that was introduced at the time of the pandemic enabled transnational resource-sharing. It also supported the creation of sustainable digital learning environments, especially in the developing world (UNESCO, 2021). In Latin America, Brazil Universidade Federal de Santa Catarina provided a case study that demonstrated that digital inclusion programmes helped to expand access to a range of digital applications in addition to reducing energy consumption per student (Silva & Barbosa, 2021).

Although, online learning has got a lot of potentials, there are a number of obstacles to overcome to fully experience its staying power. The most evident challenge is the digital divide that contributes disproportionately to the students in the low-income and rural localities. The absence of access to equipment, fast internet, and assistance in coping with technology prevents engagement in the online educational process and increases inequalities of access to education (Bozkurt et al., 2020). Also, an increased usage of technology makes people worried about e-wastes and resource-thirsty data centres. International Energy Agency (IEA, 2021) documented that data centres and networks consume almost 1 percent of all energy in the world, and it will increase unless it is balanced with the help of the green technology. There is, therefore, a need for educational institutions to take account of the lifecycle effects of the devices and platforms deployed and this should be through the use of circular economy principals, which include reuse, recycling, and procurement in responsibility (Sterling & Thomas, 2021).

To maximise the environmental impacts of online education, a multiple-faceted approach is required and should include the criteria of technological efficiency, systemic policy-making, innovative pedagogical space, sustainability indexes tracking. Institutions have the option of implementing green certification schemes in digital education schemes, carrying out carbon audits, and rewarding low-carbon practices among the students and faculties. By incorporating Environmental, Social, and Governance (ESG) standards into the educational context (particularly higher education institutions), administrators have had a way to harmonise online learning with the concept of sustainability

(Roy et al., 2021). In addition, online learning needs to spread awareness of the environmental problems, fostering eco-consciousness in learners and ensuring that they are ready to contribute to global climate resistance.

The transition to online education has raised the whole spectrum of academic research that has focused on the potentials, which this new form of education can have on the environment. Through many studies, it has been concluded that e-learning significantly cuts down the emission of greenhouse gases (GHG) due to the avoidance or diminished concern of the daily commute and the utilization of physical infrastructure (Roy et al., 2021; Lantada et al., 2020). As a comparative study, Mendoza et al. (2019) observed that by replacing in-person lectures with the delivery of lectures on asynchronous online platforms, as much as 90 percent of energy consumption could be lowered per student. The authors cited the electricity, fuel, and resource saving as the highlights of the eco-efficiency of digital education.

Lantada et al. (2020) measured carbon emissions in a blended learning approach at one of the universities in Europe and identified that education delivery formats with minimum physical presence result in a lower ecological impact per academic hour. Similarly, Singh and Moe (2022) also analysed the virtual corporate training models and identified the fact that travel reductions led to 80 percent decreases in emissions. These researchers highlighted the climate benefits of distance learning, particularly when conducted at scale on the academic landscape. On top of carbon emissions, online education makes an impact into other forms of resource efficiency. Schools, which apply e-learning formats, use much fewer sheets of paper, physical education books and school equipment (Rodriguez & Pons, 2020). The Environmental Paper Network (2020) predicted that such an approach could cut the current level of deforestation related to the education industry by anywhere between 5 and 7 per cent every year. The submission of digital work and cloud-based collaboration also reduced waste and aided paperless administrative work by institutions.

There are challenges linked to cloud computing, however. Digital platforms that are operated by data centres also increase the world energy consumption, and Hughes et al. (2022) emphasised that there is a need to balance between technologically accessible and environmentally aware society. The results indicated a necessity in green data infrastructure and environmentally programmed software design into educational technology ecosystems. Digital

sustainability has been emerging as an important scholarly concept in the last few years when researchers and policymakers attempted to bring digital transformation into compliance with sustainable development. Digital sustainability, according to Sterling and Thomas (2021), refers to the ability of digital technologies to enhance long-term ecological stability alongside equity, efficiency, and resiliency in education systems. This definition brings the environmental discourse to the social-economical spheres and that requires an interdisciplinary methodology. Leal Filho et al. (2022 developed a conceptual framework that integrates the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 10 (Reduced Inequalities), SDG 13 (Climate Action) and digital education practices. They provided that online education should not only address the issue of energy efficiency, but inclusiveness and scalability should also guide the global sustainability efforts.

The environmental side of digital education becomes ever more accentuated in policy-relevant literature. The Department for Education of the UK (2022) has developed a plan of fulfilling the goal of education institutions going carbon-neutral with online learning in the forefront. In the same line, the Indian National Education Policy (NEP) 2020 focuses on digital growth, as one of the mechanisms of attaining accessibility and sustainability in the education delivery sector. UNESCO (2021) released a roadmap to education on sustainable development (ESD), which supported the use of digital approaches to develop international citizens, upbringing their awareness of the green environment. The roadmap focuses on collaboration through digital platforms, which minimise consumption versus knowledge sharing. Furthermore, the European Commission (2022) has implemented policies in which education technology vendors are required to engage in green computing facilities, and this is a clear indication that sustainability and digital governance are becoming similar.

Empirical case studies provide hard facts of the role of online learning in lessening ecological footprint in various geographical settings. Silva and Barbosa (2021) reported an example of a programme led by a university in Brazil, which offered access to solar-powered equipment and digital data to the marginalised students. Not only did this cut emissions, but it also enhanced digital equity. As an example of countries in the Nordic region, the Ministry of Education in Finland has initiated curriculum-level changes that prepare learners to become familiar with environmental literacy alongside the domain

of online platforms (Ministry of Education and Culture, Finland, 2021). These are the digital resources, which are configured to operate on low-energy servers and go in line with climate neutrality goals of the country. In Asia, blended learning has been tested in Chinese, Indian and South Korean universities, using energy audits to support carbon tracking systems. According to Roy et al. (2021), the incorporation of online modules in Indian universities during the pandemic resulted in decreased emissions caused by the use of electricity and transport by 35460 percent.

Summarising the literature that were reviewed in this regard brought to the fore various relevant themes. First, online learning has significant qualities of a low carbon footprint with minimised journeys and use of resources to a minimum, and energy-saving activities. Second, digital sustainability comes with a four-dimensional approach to the concept, which incorporates both economic and social viability and social justice with ecological objectives. Third, although the attempts of policy and institutional approaches appear encouraging, issues like the digital divide, e-waste, and power-hungry technologies entangle the picture of sustainability. Arising from all the themes is the fact that there are longitudinal, cross-sector and Global South-based study gaps that require completion. This review highlighted how positive design of sustainable systems of online education should be comprehensive and inclusive. Since digital learning has taken a foothold in world education and it is unlikely that it will fade away, it is important to make sure that it is sustainable (environmentally and socially) in a way to secure a sustainable future of education.

Research Gaps

Although the benefits of online education in terms of the environment and operations have been largely attributed in the literature, some of the major loopholes in these studies have not been clearly filled. The majority of studies adopted preliminary short-term and cross- sectional approach, which do not address the issue of the sustainability of online learning in the long run. Longitudinal studies that follow ecological and educational performances of digital learning on the long term are lacking as well. So, the question of whether the current environmental gains are long-lasting or merely a result of a short-term reaction, like the one caused by the COVID-19 pandemic, has become very difficult to answer. Besides, there is also an enduring imbalance in the literature with a central focus of the research done in higher education

institutions based in the technologically well-developed countries in the Global North. This distorts the concept of digital sustainability as well as the insights into how it may affect K-12 education or even in developing nations of Asia, Africa, and Latin America where the infrastructural, economical, and social limitations are rather different.

Moreover, more behavioural and social dimensions of sustainability are lack in the extant studies. Not many researchers think about the influence of learners' attitudes, digital skills, and mental well-being on the effectiveness of online education systems. Screen fatigue, motivation, and accessibility in remote settings are some of the issues that shape the sustainability of the digital platform, but they are hardly ever part of sustainability assessments. Finally, the empirical research on assessing how education policy and institutional strategies can support the objectives of sustainability through the digital learning is very weak. Despite available international frameworks, like the roadmap to sustainability in education of UNESCO, there are still no universally accepted standards and indicators of performance at institutional level to structure the implementation and measure progress. These gaps in the research raise the necessity of an international and elaborated, context-responsive study of the possibilities of online learning to actually promote environmental and digital sustainability in the global education systems.

Research Objectives

1. To analyse how online learning help in minimising carbon imprints in education sector in various geographical and institutional settings.
2. To assess the influence of online education on ensuring digital sustainability by paying attention to environmental efficiency, social inclusiveness, and infrastructure.
3. To create a unified framework, composed of environmental, pedagogical, and economic indicators, to evaluate the sustainability of digital education models on the global scale.

Research Methodology

The research approach used in this study was qualitative secondary data where the researcher attempted to investigate the environmental and sustainability aspect of online learning and focused specifically on the Indian education

system. The data were collected using a variety of reliable sources such as peer-reviewed journals articles, institutional reports, policy papers and case studies concerning e-learning practices and sustainability results. Specific focus was on the accuracy of data related to digital education programmes in order to put the discoveries into the socio-economic and technological reality. This practice helped in developing a holistic picture of how and at what level digital models of education may be made to be sustainable without discriminating access to various learners within the segment.

Data Analysis

This study examined the effect online learning has on reduction of carbon footprint and digital sustainability. The evaluation aimed at determining trends, patterns, and main insights concerning the ways online learning can lead to environmental efficiency and sustainable education process. It has four dimensions namely: (1) carbon emissions and energy use; (2) digital infrastructure and resource efficiency; (3) social inclusion and accessibility; and (4) institutional strategies and policy frameworks.

Energy Consumption and Carbon Emissions Reduction

The most noticeable area in which online learning has reduced carb on emissions is in the switching of physical classroom to the virtual classroom. Other national and international studies indicated that online learning would reduce commuting emissions to a great extent. To illustrate this, one of the TERI's (The Energy and Resources Institute, 2021) reports suggested that on the verge of the COVID-19 lockdown, the local transportation emissions dropped by 15-20 percent due to the closure of educational institutions. This decline was largely attributed to the increased popularity of the online learning platforms. A study carried by Singh and Moe (2022) examining virtual learning in South Asian institutions revealed that the substitution of direct training, workshops, and courses with web-based material pointed to an 80 percent reduction in emissions on travel, paperwork, and building operations. Such results indicated that the institutional implementation of e-learning did not only continue academic life but also provided a co-benefit impact on the environment.

Information Resources and Infrastructure Efficiency

Another impact is that online learning encourages the efficiency of resources because of the minimised use of physical limitations like paper, books and

paper assignments. The usage of paper decreased due to more use of online digital learning platforms. The move to paperless tasks, e-books and cloud storage did not only reduce pressure on deforestation due to paper production, but also led to cost savings in logistic and purchasing spheres. But this information also indicated the new environmental price of digital infrastructure, especially the growth in electricity consumption by servers and internet-connected devices. The International Energy Agency (IEA, 2021) referred to global data centres that already consumed almost 1 percent of all energy needs. However, there is certain progress with pilot projects of solar-powered employee education servers, making it seem that a green version of digital infrastructure is possible.

Social Inclusion and Digital Equity

Online learning transition has been associated with complicated equity and inclusion effects, particularly among rural and low-income earners population. The Annual Status of Education Report (ASER, 2021) also provided that almost 37% of students in urban region did not have smartphones or access to the Internet during the pandemic, a factor that reduced their chances of getting involved in remote learning. This is especially a key obstacle to the vision of digital sustainability since it leaves a huge segment of learners out of the green advantages of online learning. However, the usage of radio, community centres, and solar charged tab, had worked successfully, especially in far tribal regions in some states. Such initiatives showed how digital sustainability can become socially open to solutions based on infrastructure realities.

Institutional and Policy-Level Sustainability Strategies

The study also pointed at the rising policy focus on linking education to environmental sustainability. It is time to consider technology within any educational process and enhance overall behaviour in all educational stages towards contributing to the environment and preserving the climate. In addition, sustainability systems, applied in institutions, are starting to embrace digital sustainability measures e.g., the Green Campus Movement. Some institutions and universities are making efforts to monitor and report on the sustainability outcomes of their digital education practice. These involve carbon audits of ICT business, open-source platforms to minimise licensing waste and recycling e-waste by students. Even though these practices remain rather narrow in scope, they are open to the possibility of increasing awareness

and institutional interest in creating a new balance between technological creativity and environmental responsibility.

Summary

Theme	**Insights**
Carbon Emissions	Online education significantly reduces transportation and infrastructure-related carbon output.
Resource Efficiency	Shift to digital tools leads to major savings in paper and printing-related energy consumption.
Infrastructure Challenges	Data centres and device usage increase energy demand, requiring renewable integration.
Social Inclusion	Rural and low-income students face barriers; hybrid and offline models help bridge access gaps.
Institutional Responses	Some universities and policies have started integrating sustainability into digital strategies.

Online learning, therefore, provides significant opportunities in terms of diminishing the carbon footprint of the education sector and developing digital sustainability. Nevertheless, these advantages are not equally distributed, but they depend on the availability of digitalisation, infrastructure preparedness, and institutional sustainability dedication. The different cases prove the potential and the shortcoming of digital learning as a sustainability practice. Although the carbon saving and the paper-saving can be easily identified, difficulties regarding the energy-intensive infrastructure and the social inequality have to be eliminated by means of the inclusive policies and the green technological innovation. It can be considered an essential source of basis in creating an overall and context relative framework to govern sustainable digital education in the world.

Major Findings

The results of this study are subdivided according to the research purposes.

Carbon emissions decreased considerably because of online learning.

Among the most important results of this study is that online education leads to significant reductions in carbon footprint of the education sector. The digital

platforms can easily replace the physical attendance in the classroom and, consequently, significantly reducing the number of transportation-related emissions, energy spent on campus facilities, and dependence on paper-based resources. Many universities and educational institutions case studies demonstrated a significant reduction in emission during online mode of learning during COVID-19 pandemic. This decrease was as a result of the reduced travel of students and faculty members, air-conditioned building occupancy and physical infrastructure use. Such results are consistent with the reported developments of trends globally and in other studies on the same topic, proving the ecological benefit of virtual learning environment.

Less Resource Consumption Improves Sustainability of Operation

Besides less carbon emission, online education has resulted in operational sustainability in the educational processes since there is more efficient use of resources. The fact that digital textbooks, e-assessments and collaboration tools can be used extensively reduces the number of papers, printing and even physical storing needs. Institutions learning management systems (LMS) have facilitated the shift to near-paperless mode of study by thousands of students and faculty members. The shift does not only help to conserve the environment, it also cuts on the costs of running operations, thus helping the economic aspect of sustainability. But this is only when institutions have strong digital platforms and the pupils can access an acceptable number of gadgets and internet services.

Digital Infrastructure is Costly to the Environment in Two Ways

Although digital learning alleviates the conventional environmental stressors, this research concluded that digital learning actually estimates novel types of carbon-intensity- the energy consumption of information centres, server farms, and manufacture and disposal of electronic devices. Such expenses are not always shown in institutional accounts. Online learning can be indirectly related to carbon emissions since it requires a lot of server farms supported by electricity powered by conventional power grids. Also, the increased amount of e-waste, because of high device replacement cycles and an absence of official e-waste recycling regulations in schools, contribute to environmental pressure. Therefore, online learning sustainability depends on environmental factors, which have to be complemented by green buying, energy-efficient coding and renewable energy sources usage.

Online Learning has Digital Divide Limit Equitable Sustainability

The unfair availability of digital resources is another important discovery. This has posed a big challenge to the realisation of possible digital sustainability universally. The leaners in the urban and wealthy population enjoy smooth online learning experience, but the leaners in the rural places and marginalised regions are impeded by poor internet access, absence of digital gadgets and low digital literacy levels. Such inequalities negate the diversity of digital learning and make the environmental advantages of online teaching available to a small population group. Students in most cases turned to printed study references or offline media, thus reducing the carbon saving that was to be achieved through digitization.

Behavioural and Psychological Sustainability is Usually Neglected

The research concluded that online learning contributes to the environmental sustainability, but it does not usually contribute to psychological and behavioural well-being, which are critically important part of the sustainable education. The concern among students and teachers includes high screen time, minimal peer interaction, and digital fatigue, especially when students are required to be online over prolonged durations. These factors have adverse impact on student engagement, motivation, and retention and look at the viability of long-term online education models in a negative light. Since sustainability is ecological as well as social and psychological, these results indicated that any digital learning strategies should involve the application of wellness design, flexible and dynamic schedules, and interactive teaching methods to create modalities that elicit resiliency among the learners.

The Policy initiatives are progressive but have no measurable sustainability metrics.

Under National Education Policy (NEP) 2020, the Indian government has introduced various digital education promotion programmes. SWAYAM, e-PG Pathshala, Virtual Labs and many other several initiatives are good towards scalable and sustainable digital education. Nevertheless, the research revealed that there is few institutional hybridisation of sustainability indicators, e.g., the number of carbon emissions saved, the amount of paper use avoided, or energy savings due to digital transition, etc. Such a gap is a drawback in terms of the strategies and openness needed to track the progress towards sustainability objectives.

The Need of Integrated Frameworks to Evaluate Sustainability of Digital Education

The last important conclusion is that the extant literature and institutional activities do not have a composite framework in terms of which the sustainability of digital education, environmentally, pedagogically and economically, is determined comprehensively. The majority of literature that exists concentrates on a single variable of environmental without considering the dynamics of other variables such as digital inclusion, quality learning, and economic efficiency. It requires a multidimensional model, which would allow policymakers and educators alike, to make informed decisions regarding the long-term viability of online education. Examples of such indicators to be included in such a model include carbon saving per student, levels of digital engagement, an analysis of infrastructure lifecycles, and socio-economic accessibility indicators.

Summary of Major Findings

Key Focus Area	Major Findings
Carbon Emissions	Online learning reduces carbon footprints through less commuting, facility usage, and paper consumption
Resource Use and Cost	E-learning promotes operational efficiency and cost reduction through digital resources and tools
Digital Infrastructure	Environmental costs of data centres and e-waste must be addressed to sustain long-term digital benefits
Digital Equity	Internet and device access gaps in rural India limit the inclusive sustainability of online learning
Student Well-being	Psychological fatigue and reduced engagement are barriers to behavioural sustainability in digital formats
Policy and Monitoring	Lack of carbon audits, benchmarks, and institutional metrics restrict measurement of sustainability progress

Framework Development	Need for a comprehensive sustainability assessment model covering environmental, social, and educational dimensions

Conclusion

This study has addressed the topic on how online learning minimises carbon footprints and increases digital sustainability in both the education system. The study offers substantial evidence that online learning can potentially reduce the negative environmental impact of the usual learning systems to a considerably high degree. Online platforms can radically reduce the carbon footprint related to the traditional system of education by minimising transportation to schools and workplaces by both students and faculty, and by reducing the physical infrastructure required to access learning resources as well as promoting the use of digital learning resources. The advantages of online learning, however, do not come automatically without some other drawbacks. The energy consumption of data centres as well as the emerging hazard of e-waste and the disparity in the access to digital activity are sustainability issues of real concern. The psychological issue, arising from online learning, is also a concern. The psychological issue include digital fatigue, less social interaction, and the stress caused by the level of screen-time exposure, all indicating that digital education needs an upgrade to a holistic level culminating into learner-focused education. The results of this study supported the idea for institutions and policymakers pursuing a comprehensive and site-specific approach to sustainability. Sustainability in education must be defined not only through carbon reduction levels, but also through inclusive access and sustainability as well as well-being of learners. In the absence of such multidimensional approach, online learning can lead to the duplication of some of the structural inefficiencies of conventional learning, or even lead to an increase in similar inefficiencies.

Future Implications

This research is significant to the policymakers and all educational institutions. It is also beneficial to the global sustainability agendas. Specifically, the study contributes to:

Development of Policy and its Monitoring

Regulatory bodies of education and governments must work on generating standard frameworks and sustainability indicators that pertain to digital education. This should incorporate periodic carbon audit, energy performance rating of learning platforms and specific information on green procurement and recycling of e-wastes.

Institutional Capacity Development

Sustainability needs to be addressed in the strategic planning of educational institutions, which should consider the introduction of special sustainability units, faculty training programmes on green digital practices, and the involvement of students in environmental activities on campus associated with digital learning.

Combination of Well-being Metrics

The design elements of future models of online learning need to consider the learner wellness, offering such features as screen-time control options, blending interaction opportunities, and adaptive learning environments. This will allow students to coordinate pace and format according to their feedback.

Global Collaboration

Since digital education is of transnational character, international collaboration will play a key role. Common frameworks, research alliances, and lasting technology alliances can be used to create scalable, equitable and environment friendly world education ecosystems.

Limitations of the Study

Although this study presented helpful insights into the extent to which online learning influenced the reduction of carbon footprints. The study was based on secondary data. Therefore, the results of the study depended on the extent of the reliability of the institutional reports and policy documents that were consulted. This study was not empirical; it did not gather primary data to measure the emissions in real-time, or statistically model the indicators of sustainability. Future study on this issue must, therefore, adopt empirical approach, using survey, lifecycle carbon analysis, or mixed methodological strategy. Besides, the analysis in this study was essentially specific to a country and not applicable to all countries.

Even with these limitations, the work provided a vigorous conceptual basis on future study and policy formulation on the attitude alignment of online education with the goals of sustainability.

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CHAPTER TWENTY-SEVEN

A Critical Review of Ethical Issues in STEM Teacher Education in Nigeria

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Abstract

In an era where technological and scientific advancements are pivotal to national development, this study examined the state of STEM (Science, Technology, Engineering, and Mathematics) education in Nigeria. It aimed to dissect the complexities, challenges, and opportunities within this educational sector, particularly in the context of global educational trends and national developmental imperatives. The study reviewed ethical issues in STEM teacher education in Nigeria. It clarified the concepts of ethics, norms, and what constitutes STEM Teacher Education. The study concluded that, beyond professional ethics, STEM teachers also need grounding in ethical theories and moral thinking skills. The study advocated for the inclusion of core courses on ethical theories and moral thinking skills into the STEM teacher education curriculum in Nigeria.

Keywords: Education, Ethics, Ethical dilemma, STEM, Teacher education.

Introduction

The trajectory of Science, Technology, Engineering, and Mathematics (STEM) education in Nigeria has been a gradual process, marked by some challenges and opportunities. Arising from a global acknowledgement of the significance of the STEM field, and despite the progress made, STEM education in Nigeria still faces numerous challenges, including inadequate funding, unstable education policies, and a lack of adequate support (Agboola, 2021).

The government's acknowledgement of the importance of STEM fields led to the founding of several federal universities specialising in science and technology, with a specific focus on enhancing STEM teaching and learning. These institutions marked the beginning of a structured approach to STEM education in Nigeria, focusing on creating a skilled workforce capable of driving technological advancement and innovation. Despite the government's

investment in STEM education, the sector has struggled with a multitude of challenges, including inadequate resources, insufficient infrastructure, and a shortage of qualified educators. Agboola (2021) identified key challenges, including poverty, underfunded schools, untrained teachers, and lack of educational resources. These numerous significant challenges pose a threat to the successful implementation, growth, and sustainability of STEM education. Despite the efforts to promote STEM education, women and girls remain significantly underrepresented in these fields, with less than 30% of STEM researcher worldwide being women, and only around 35% of students enrolled in STEM-related higher education were female.

Tim (2017 noted that mankind is arguably the most dominant and intelligent species on earth with the most complex social behaviours. Ethics, according to Frolov (1984), is a theoretical field of study concerned with the studies of morality, which emerged during the early days of the slave-owning society. It emerged from the spontaneous moral consciousness of society. Peter (2020) noted that ethics is a branch of philosophy that deals with "what is morally good and bad as well as what is morally right and wrong". Ethics applies to theory or any system of moral values or principles. Ethics has helped in the categorisation of different values such as integrity, discipline and honesty. Ethics influences our individual behaviours and guides in making the right decision. It is an important concept that helps to regulate life and act of responsible behaviour. The importance of ethics in society, and in the field of education in particular, cannot be over-emphasised. Ethics in education are generally essential as they play a prominent role in the smooth running of the education industry. It sets the standards of what is acceptable and what is not acceptable in teaching and learning situations. The onus then lies on teachers to share the acceptable ethics during their training to students to guide their daily conducts in society.

Norms, on the other hand, refers to a set of standardised ways of behaviour and conduct in a society, community or organisation. It deals with appropriate societal standards of behaviour, the morals used in making value judgments by individuals and society in general. According to Young (2015), norms are:

> ...patterns of behaviour that are self-enforcing within a group: Everyone conforms, everyone is expected to conform, and everyone wants to conform when they expect everyone else to conform. Social norms are often

> sustained by multiple mechanisms, including a desire to coordinate, fear of being sanctioned, signalling membership in a group, or simply following the lead of others.

STEM Teacher Education can be conceptualised as comprehensive programmes which consist of pedagogical theory, disciplinary knowledge, teaching, and professional skills designed to produce professionally competent, efficient and effective teachers in the fields of Sciences, Technology, Engineering, and Mathematics. In general, teacher education is a specialised professional programme designed for prospective and in-service teachers to acquire knowledge, skills and attitudes necessary to make them efficient and effective facilitators of learning. (Osuji 2009).

Ethical Standards for STEM Teachers in Nigeria

The mandate of the education industry extends beyond the production of literate citizens, and the required manpower for sustainable national development. It also includes producing morally upright citizen for the common good of society. Indeed, teachers are often regarded as "Moral Compass" for students in view of their expected significant roles in moral upbringing of students. Hence, ethical issues and social norms take centre stage in the field of teacher education. Since teachers can teach only what they know, pre-service and in-service teachers are equipped with the required ethical standards and social norms through teacher education and teacher professional development programme.

Ethical standard in teacher education refers to code of conducts that regulate the behaviour and relationship of teachers with students, colleagues, school administration, parents as well as society. As observed by Rasmi, Lakshmipriya and Santosh (2014), ethical standards in teacher education deals with basic principles, procedures and behaviour patterns which is based on dedication and commitments to core values that are deeply rooted in education system. The Teacher Registration Council of Nigeria (TRCN) (2013) rightly noted that:

> No profession can stand without clearly defined "dos" and "don'ts" representing the core values that the profession shares and holds tenaciously. Teaching in particular deals with the moulding of character of humanity and itself must

> rest on a set of solid, tested and proven ethical framework that guarantees the very best atmosphere and trust in the teaching-learning process.

In keeping with international best practices and ethical standards in teaching profession, teacher education programmes mandatorily equips both pre-service and in-service-STEM teachers in Nigeria with professional ethics and norms. These professional ethics and norms otherwise known as teachers' code of conduct, which teachers are obliged to adhere to as spelt out by the TRCN (2013), are as follows:

- **Respect:** Teachers are obliged to respect each other in all circumstances irrespective of their cadre and must also assist each other to attain highest professional goals.
- **Symbiotic relationship**: All teachers are under obligation to establish symbiotic relationship with their colleagues for mutual benefits and uplifting the profession to a lofty height.
- **Responsibility:** Senior teachers are expected to display a high sense of responsibility and self-respect and take up the responsibility of bringing up junior colleagues professionally. Junior colleagues are under obligation to also respect their senior during formal and non-formal interactions; and must exhibit readiness to learn from them.
- **Loyalty:** Teachers are expected to exhibit a high sense of loyalty and co-operate with professional colleagues to enhance the achievement of professional goals.
- **Integrity**: Teachers are under obligation to display honesty, be trustworthy, and respect persons and property.
- **Discrimination:** Teachers are expected to have zero tolerance to discrimination on the basis of, religion, culture, race, gender, and so forth. They are, hence, obliged to relate equally with every person.
- **Defamation of colleagues:** In all circumstances, teachers are prohibited from making derogatory remarks about their colleagues; and should not lower each other's integrity.

- **Touting:** Teachers are prohibited from depriving their colleagues of clients and learners through misinformation, or any other unethical means.
- **Canvassing**: Teachers are forbidden to gain undue advantage over their colleagues by advertising themselves that they possess extra-ordinary knowledge and skills that they do not actually have.
- **Team work:** Whenever the need arises, teachers are expected to work as a team and equally seek for assistance from colleagues when undertaking tasks beyond their professional ability.
- **Plagiarism:** Teachers are under obligation to adhere very strictly to copyright laws and regulations. They are obliged to recognise the intellectual contributions of colleagues by refraining from all forms of plagiarism.

In addition to the forgoing ethics, guiding teacher's relationships with colleagues, there are also ethical standards that guide the relationship between teachers and students as summarised below:

- **Learner's right and dignity:** Teachers are required to respect the learner's right and dignity irrespective of their gender, race, religion, tribe, colour, physical characteristics, place of origin, age, and so forth.
- **Responsibility for educational programmes**: Teachers are required to professionally discharge their duties as facilitators of learning diligently.
- **Empathy**: Teachers are obliged to understand and share the feelings and circumstances of their students at all times.
- **Confidentiality:** Teachers are under obligation not to divulge students' confidential information except in the interest of the learner, parents/guardians, public and when required by law.
- **Fair remuneration:** Teachers are not expected to collect gratifications, bribes or any money for services already paid for by the employer.
- **Sexual misconduct and related abuse of office**: Teachers are prohibited from using their position to sexually harass, blackmail or intimidate their students. They are equally prohibited from promoting,

aiding and abetting sexual misconduct, drug addiction and trafficking, cultism, human trafficking among other criminal conducts.

- **Examination malpractice:** Teachers are prohibited from aiding and abetting examination malpractice by students.
- **Patronage of illegal learners' groups:** Teachers are required to refrain from patronising illegal and immoral student groups such as secrete cults, gay and lesbian.
- **Role model:** Teachers are obliged to serve as good role model to learners in their daily conducts such as decency in speech, mannerism, discipline, dressing and discharge of their duties.
- **Corrupt practice:** Teachers are prohibited from engaging in any form of corrupt practices such as asking or receiving gifts, gratification for themselves or for their colleagues.
- **Corporal punishment:** Teachers are forbidden to administer corporal punishment on their students without the permission of the school authority.
- **Discipline**: Teachers are to ensure that students behave in a civil and disciplined manner.
- **Ideological influence:** Teachers are prohibited from imposing or spreading their ideologies among learners.

There are also ethical standards that guide the relationships between the teachers and their employer, parents, and the pubic among other stakeholders. For instance, teachers are obliged to respect and provide relevant information about students and school to parents; take active parts in parent-teacher association. They are prohibited from taking gifts, favours, and hospitality from parents to avoid showing favouritism to any student. They are obliged to respect agreement between their union and employers, fulfil their contractual agreements with their employer and perform only tasks within their professional training (TRCN 2013).

Ethical Component of STEM

In addition to the forgoing ethical standards and norms, there are also, ethical standards that guide the daily activities of the scientific community such as curiosity, honesty, that constitute the ethical component of the structure of

science. According to Abimbola (2013), every STEM teacher should be conscious of these ethical standards, teach and exhibit them as professionals. They include but not limited to the following:

- **Seeking Relationship among Data:** Scientists should seek for relationship among data and formulate generalisation in form of concepts, laws and theories.
- **Anti-authoritarianism:** No scientist or group of scientists is allowed to enforce strict obedience to their authority at the expense of personal freedom of other scientists to conduct their research. Authority lies in the logic of man, data from nature, and the force of the scientific community.
- **Positive Approach to Failure:** Scientists should regard every failed attempt as an indication that there is a better way of doing it. The lesson from failure is that one way of not doing the same thing has been learnt. Scientists, therefore, should not become moody due to failure during experimentation.
- **Objectivity**: All scientists are under obligation to willingly consider many sides of an issue without any form of prejudice.
- **Open-mindedness:** Scientists are obliged to always willingly be receptive to new information or idea and examine all planned or unplanted information.
- **Commitment to the Goals of Science:** The goal of science is the formulation of relatively small number of basic concepts to explain natural phenomena.
- **Suspension of Judgments**: Scientists are obliged to always willingly suspend judgments in the absence of all necessary facts/date. Conclusions must be delayed until necessary facts are available.
- **Curiosity:** Scientists should be very curious, desiring to know more and thus must not be satisfied with the status quo.
- **Accurate Observation:** It is an obligation for every scientist to ensure that observations are accurately made and recorded. Although observations are theory–laden, it must be free from bias of the observer as far as possible.

- **Morality:** In the field of pure sciences, scientists are not under obligation to be concerned with the moral implications of their research work. However, in the field of applied sciences, scientists should consider the moral implications of their studies.
- **Communication:** Scientists should make their findings known to the scientific community.
- **Scepticism**: Scientists are to willingly question the status quo by maintaining some degree of a doubting attitude (Abimbola, 2013).

Unlike the teachers' code of conduct that features prominently in a compulsory course, (EDU 111: Introduction to Teaching Profession) in the teacher education curriculum in Nigerian universities, the ethical component of science does not have the same status.

Ethical Issues and Dilemmas Facing STEM Teachers

STEM teachers often encounter conflicting interests in dealing with ethical issues when discharging their responsibilities. For instance, a teacher may be mandated by the principal to teach a subject other than his/her field of specialisation. Unscrupulous school management sometimes equally engages teachers to aid and abet examination malpractices (WAEC, 2020) or to collect illegal financial charges. Sometimes, the school principal may mandate teachers to give preferential treatment to student(s) due to intense pressure from influential parents. Similarly, a teacher may be aware of close friend(s) among his/her colleagues that covertly violates ethical standards such as trading mark for sex, and falsification of grades. There are also situation where student(s), out of frustrations, act provocatively to embarrass the teacher in the class. These and many more similar scenarios abound in schools, posing ethical dilemmas for teachers on daily basis. Teachers are expected to resolve these ethical issues appropriately without jeopardising their job and professional standards.

Teachers need more than mere familiarity with professional code of conduct to resolve these ethical challenges. The understanding of ethical dilemmas and how to resolve them adequately can be achieved by the application of ethical theories and moral thinking skills such as the Four Component Model of Moral Maturity propounded by Rest and Narvaez (1994). When faced with ethical dilemmas there is a tendency to rely on the four-component model to resolve

the dilemmas. Three levels of moral maturity in resolving ethical dilemmas are recognised under the model as follow:

a- The personal interest level: At this most basic level of moral maturity, dilemmas are resolved based on the direct advantage to the person under focus. There is no consideration of the impact of one's conduct on others; rather, emphasis is on doing what is considered to be the best for oneself, family and friends' approval. The need to serve one's interest is paramount at this level.

b- The maintaining norms level: Resolution of dilemmas at this next level is on the basis of maintaining the existing legal system, rules, societal and professional norms. Conducts are considered to be right as long as it contributes to profession, group or society in general. Laws are strictly adhered to except in few exceptional cases.

c- The post-conventional Level: This is the peak of moral maturity. Resolutions of ethical dilemmas are on the basis of general agreement through consensus such as majority vote, and appeal to moral principles such as adherence to due process and recognition of basic rights. The paramount focus is to uphold basic rights, societal values, and laws, even when they conflict with the rules and laws of the group.

Applying these three moral maturity levels to resolve ethical dilemmas in schools is not as easy as it seems to be. Naturally, teachers are sensitive about the ethical implications of their relationship with colleagues, students and other stakeholders. The three levels of moral maturity are thus a useful framework to address ethical dilemmas (Jacques, 2013). Ethical dilemmas calls for meaningful understanding of moral theories and their applications in real life situations by teachers. However, moral theories as a compulsory course are yet to be integrated into STEM teacher education in Nigeria.

Scientific and Technological Advancements do also raise ethical issues that STEM teachers have to respond to in the class. For instance, English (2019) reported that Chinese scientists are already producing 'designer babies' because advancements in genetics now enables scientists to edit human genome by altering the DNA sequences and change how genes function to prevent the spread of genetic diseases. This implies that scientists can now select and design the genetic qualities of a child to produce 'designer babies'. The long-time effects of this practice are unknown, and it calls into question

the definition human. Similarly, the trial of drugs and consumer products, such as cosmetics in animal, places the suffering of human over the sufferings of animals. While this may sound appropriate in cases of production of drugs to improve human health, it is a moral burden to subject animals to sufferings just to produce cosmetics (English, 2019). Experiments on human embryo and stem cell also raise ethical issues as they violate human dignity. Advancements in engineering have led to the evolution of autonomous machine such as driverless cars and killer drones. Autonomous machines work without human control and can take decision independent of human interference. The moral question here is: who is to be held accountable for the actions taken by these autonomous machines? (University of Notre Dame 2012).

STEM teachers are required to explain and discuss recent developments in their respective disciplines during class lessons. Hence, they have to be adequately prepared to address ethical issues that arose from such advancements with their students. To achieve this, STEM teachers need adequate grounding in ethical theories and moral thinking skills apart from keeping abreast with ethical issue related to the advancements in their field.

Conclusion

STEM teachers are expected to serve as moral compass in society. To this end, teacher education programme in Nigeria equipped them with professional ethical standards, which is also known as teachers' code of conduct. A society devoid of ethical conducts is inconceivable because individuals react differently to moral values and strict adherence to ethical standards is easier said than done. In discharging their responsibilities, STEM teachers often encounter ethical dilemmas almost on a daily basis. There seems to be no evidence in literature that teacher education programme in Nigeria equip STEM teachers with the ethical theories and moral thinking skills required to resolve ethical dilemmas. Similarly, the ethical component of the structure of science is yet to find a prominent place in STEM teacher education programme in Nigeria. STEM teachers obviously need beyond professional code of conduct; they also need grounding in ethical theories and moral thinking skills to address ethical dilemmas and issues in science and technology.

Recommendations

- The curriculum of STEM teacher education in Nigeria should be expanded to include course(s) on ethical theories and moral thinking

skills so as to enable teachers to adequately address ethical dilemmas they encounter when discharging their duties.

- The introduction of a course on STEM and Ethics should equally be integrated into the STEM teacher education programme.
- Teacher education institutions should place more emphasis on the ethical / moral conducts of STEM teachers right from the time they are admitted into teacher education programme.
- STEM teachers must always be conscious of their role not only as facilitators of learning but also as moral compass.
- Textbook authors should include ethical issues in teacher education, and in STEM textbooks.
- The Teachers' Registration Council of Nigeria, Science Teachers' Association of Nigeria, Mathematics Association of Nigeria, and Science Association of Nigeria should regularly keep teachers abreast of ethical issues in STEM through regular workshops and conferences.

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CHAPTER TWENTY-EIGHT

Internationalisation of Higher Education in South Africa: A Qualitative Case Study

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Abstract

Internationalisation of higher education has become a global trend, with African universities increasingly engaging in cross-border collaborations, student and faculty mobility, and curriculum internationalisation. Notable among the African countries pursuing rigorous internationalisation is South Africa, which has developed comprehensive policy frameworks aimed at addressing past inequalities and aligning with democratic values. It is against this background that this study examined the opportunities for internationalisation in higher institutions. This study adopted a qualitative research design using the case study approach. The purposive sampling technique was adopted to select academics of different nationalities with tenured appointments in South African universities. Data, which were collected using interviews and documentary analysis, were analysed using thematic analysis. Findings from the study revealed enhanced academic quality and curriculum development, increased research collaboration and knowledge exchange, faculty and student mobility, and economic and institutional growth as some of the opportunities arising from internationalisation and collaboration. The challenges identified included funding constraints and economic barriers, unfriendly policy and regulations, limited institutional capacity, geopolitical and safety concerns and brain drain. This study concluded that, as a leader in Africa's internationalisation of higher education, South Africa presents numerous opportunities for scholarly cooperation, economic development, and cross-cultural interaction. It is recommended that South Africa support the growth of higher education across Africa, among other initiatives.

Keywords: Internationalisation, Higher education, African universities, Globalisation.

Introduction

The internationalisation of higher education in Africa has been a growing trend, driven by globalization, technological advancements, and a desire for improved educational quality and competitiveness while emerging as a pivotal force in shaping academic institutions worldwide. This process involves the cross-border exchange of students, faculty, curricula, research collaborations, and institutional partnerships. The internationalisation of higher education has become a global trend, with countries seeking to enhance their educational systems through cross-border collaborations, student mobility, and academic exchange programs. African universities want to increase their worldwide visibility and competitiveness as globalisation continues to integrate economies, cultures, and knowledge systems. Increased staff and student mobility, cross-border cooperation, the use of global curricula, and involvement in worldwide research networks are all part of this dynamic (Shen et al., 2022). In Africa, internationalisation presents an opportunity to bridge knowledge gaps, improve academic standards, and foster global competitiveness. The growing need for high-quality instruction and research cooperation is one of the main forces behind internationalisation in African higher education. Cross-border knowledge exchange has become necessary as a result of globalisation, leading African universities to look for collaborations with organisations in North America, Europe, and Asia. Additionally, internationalisation fosters cultural exchange, equipping students with global competencies essential for navigating international labour markets. These collaborations facilitate student and faculty mobility, joint research projects, and curriculum harmonisation, thereby enhancing the global standing of African universities (Suntharalingam, 2024).

One of the key opportunities in the internationalisation of higher education in Africa is the potential for knowledge transfer and skill development (Moshtari & Safarpour, 2024). By partnering with global institutions, African universities can benefit from exchange programmes, faculty collaborations, and joint research initiatives while solving the problem of educational inequalities (Jowi, 2024). These partnerships enhance academic standards, expose students and faculty to diverse perspectives, and contribute to institutional capacity building. Moreover, international collaborations facilitate access to cutting-edge research and technological advancements that may otherwise be inaccessible due to financial and infrastructural constraints (Jowi, 2024). Private sector

engagement and public-private partnerships (PPPs) also present significant opportunities for the internationalisation of African higher education. By collaborating with industries and multinational corporations, universities can secure funding for research, develop industry-aligned curricula, and facilitate internships and job placements for graduates. Such partnerships can enhance the employability of African students while ensuring that higher education institutions remain relevant to evolving global economic needs (de Wit & Altbach, 2020).

However, the continent grapples with constraints such as inadequate funding, regulatory barriers. The COVID-19 pandemic underscored the urgent need for digital transformation in higher education, as many African institutions struggled to transition to online learning models (Mugimu, 2022). Furthermore, the digital divide continues to be a major obstacle to internationalisation in African universities. While many institutions in developed countries have embraced digital learning and virtual collaboration, limited internet access and outdated technological infrastructure in Africa pose major challenges (Oladele, 2024). Higher education institutions in Africa frequently have asymmetrical relationships with their counterparts in the global north, which results in unfair collaborations and little local control (Molosi-France & Makoni, 2020). This problem is aggravated by the critical issue of brain drain, where talented students and academics migrate to institutions in developed countries in search of better opportunities. This phenomenon depletes local talent pools, weakening African universities' capacity to conduct cutting-edge research and provide quality education (Scholarworks & Osigbesan, 2021).

Language and cultural barriers also pose challenges to the internationalisation of higher education in Africa (Msomphora, 2025). While many African colleges use English, French, and Portuguese as their main languages of instruction; nonetheless, linguistic diversity across the continent can make regional and global cooperation more difficult. Additionally, Western-dominated academic frameworks often overlook indigenous knowledge systems, limiting Africa’s contribution to global scholarship. Addressing these challenges requires a more inclusive approach to internationalisation that values local knowledge systems while promoting multilingual competencies (Murove, 2018; Ndaipa et al., 2023).

Despite these hurdles, African countries should take proactive steps to enhance the internationalisation of their higher education sectors. Initiatives such as the

African Union's Continental Education Strategy for Africa (CESA) 2016–2025 aim to foster academic mobility, strengthen research networks, and harmonise higher education systems across the continent (African Union, 2016). Additionally, regional frameworks like the African Higher Education Harmonisation and Quality Assurance Initiative (HAQAA) seek to align academic standards with international benchmarks, thereby improving the global recognition of African degrees (de Wit & Altbach, 2021). There is a significant push towards intra-regional academic collaboration in Africa. This includes the establishment of agreements and cooperation within the Southern African Development Community (SADC) and other regional bodies to enhance academic mobility and curriculum internationalisation (Kabeya et al., 2022; Southern African Development Community (SADC), 2022). This initiative has attracted the European union collaboration (European Union, 2021); showing that South Africa, is one of the continent's leading higher education hubs. It is therefore not surprising that 6.5 per cent of the total number of enrolments in universities in the country are international students, which is a significant proportion of the student body as reported by the Council for Higher Education reported (Banda & Zungu, 2024). Furthermore, South Africa has created extensive policy frameworks to direct the internationalisation of higher education to remedy historical injustices and conform to democratic ideals. The reported statistics and policy effort provide a compelling case for this study. In the light of this, this study investigated the prospects for internationalisation in higher education and explored both the opportunities and challenges associated with internationalisation in South Africa.

Objectives of the Study

1. Examine the strategies of internationalisation of higher education in South Africa.
2. Determine the opportunities of internationalisation of higher education in South Africa.
3. Examine the challenges of internationalisation of higher education in South Africa.

Research Questions

1. What are the strategies of internationalisation of higher education in South Africa?

2. What are the opportunities of internationalisation of higher education in South Africa?
3. What are the challenges of internationalisation of higher education in South Africa?

Conceptual Framework

The conceptual framework for this study examined key themes on internationalisation of higher education in Africa, consisting of strategies, challenges and opportunities as shown in Figure 1.

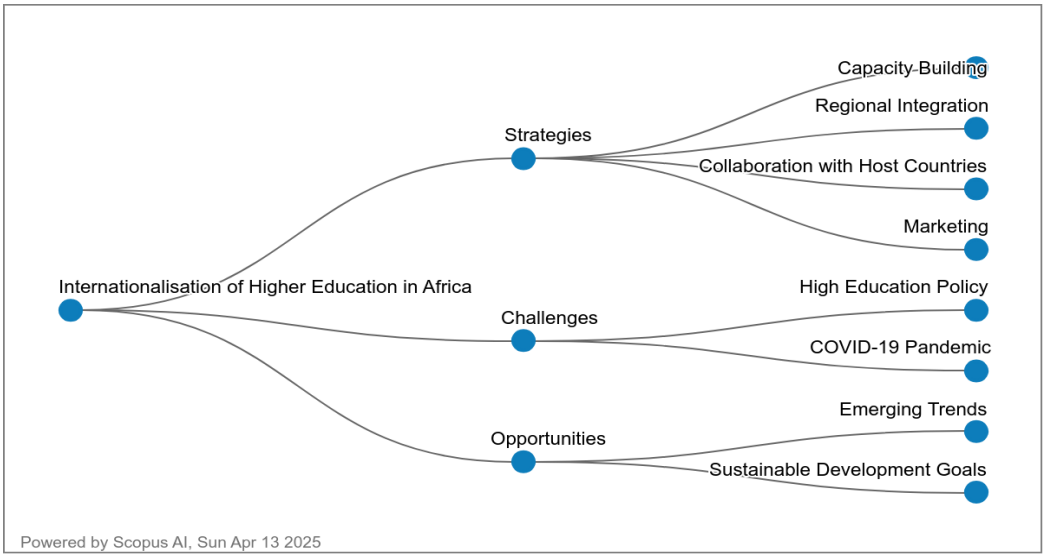


Figure 1: Conceptual Framework on Strategies, Challenges and Opportunities for Internationalisation in Africa

Internationalisation can be critical in assisting developing nations in overcoming issues like poverty, climate change, and educational disparities, as the need to push the frontiers of research to create new technologies and significant global projects grows. However, there is a dearth of research on the internationalisation of higher education in less developed African nations, even though higher education institutions have long experienced difficulties in this process, which have drawn scholarly attention in recent decades (Moshtari & Safarpou, 2024). While internationalisation is an emerging area, there are challenges in understanding the nitty-gritty of the concept. Some of these challenges are a lack of clear policies and inefficient organisational structures, which hinder internationalisation efforts (Kasenene, 2011; Pindado et al.,

2023). Other significant barriers are limited financial resources, inadequate infrastructure, and equipment shortages (Dirckinck-Holmfeld et al., 2023; Oladele, 2024). Weaknesses in scientific, skill, and language competencies, along with cultural differences, are also a major concern (Ram, 2020; Zickafoose et al., 2024), while the problem of brain drain constitutes another major challenge (Bhardwaj & Sharma, 2023). The loss of talent can impede economic growth and development, as this has become a major worry, especially for developing countries.

Despite these challenges, internationalisation offers many opportunities in the areas of developing clear policies and visions, planning for human resource development, and sustainable budgeting (Moshtari & Safarpou, 2024). National and international collaboration can aid the development of national policies and participation in international meetings to leverage scientific and economic capacities. Haley et al. (2024), however, stressed the possibility of universities in the wealthy and powerful global North using international cooperation more and more to become more competitive and market-oriented. Additionally, regional approaches and collaborations, such as the proposed continental credit accumulation and transfer system, can facilitate academic mobility and curriculum internationalisation (Ayadi & Ronco, 2023; Jowi, 2024).

The impact of internationalisation on higher education in Africa manifests in the areas of ensuring the quality and relevance of education through re-assessment of academic degrees and diplomas (Mkwananzi & Mukwambo, 2024; Ndaipa et al., 2023). It also helps in addressing issues of access and equity in higher education, particularly in the context of regional research and developmental needs (Amutuhaire, 2023; Dervin, 2024; Tight, 2022) and Sustainable Development Goals (SDGs, with higher education institutions playing a crucial role in its achievement, particularly in providing quality education and promoting sustainable development (Association of African Universities, 2021; Berchin et al., 2023; Lim, 2024; Toman et al., 2023).

Methodology

This study employed a qualitative case study research design, which entailed collecting and analysing data from reports, documents, and interviews. This design was deemed appropriate for exploring and understanding the opportunities and challenges of the internationalisation of higher education in Africa, while delving in depth into how it is being pursued in South Africa (Falaye, 2018). The population of this research comprised foreign academics and researchers at South African universities, from whom key informants were purposively sampled using a random purposive sampling technique. Therefore, faculty and postdoctoral researchers who were non-nationals of South Africa were sampled for the study, with a sample size of 7 participants. This sample met the minimum requirement of four to five cases for a qualitative case study design (Creswell, 2014; Ahmed, 2025).

Primary data were collected through in-depth interviews with key informants, an approach appropriate for understanding a broad range of people and settings, collecting detailed information, and studying past events of significance. The interviews were conducted face-to-face using Microsoft Teams, and each session lasted for about twenty to forty minutes. On the other hand, secondary data were generated from screenshots of documented evidence of postdoctoral research fellows' institutional access, based on their affiliations to universities in South Africa. In analysing the collected data, the recordings were automatically transcribed via Teams during the interview session to produce the interview scripts, which were thematically analysed according to the study's research questions.

Ethical Considerations: All requirements for studies involving human participants were adhered to in line with the ethical standards for research.

Results and Discussion

Research Question 1: What are the strategies for the internationalisation of higher education in South Africa?

Based on the coded data, the findings suggest that the internationalisation of higher education in South Africa is primarily driven by government-supported incentive structures and the recruitment of international academic talent. Two overarching themes emerged.

Theme 1: Policy and Funding Mechanisms as Drivers of Internationalisation. This theme captures how government policies and funding structures encourage universities to internationalise their academic communities and research output.

Sub-theme 1.1: Performance-Based Funding: Participants indicated that government funding is largely linked to institutional performance. Universities are therefore motivated to enhance their competitiveness by recruiting high-quality scholars and students from different countries who can contribute to institutional productivity.

"The majority of the fund they provide in South Africa is performance-based funding, where the funding you get sometimes depends on your level of performance."

Sub-theme 1.2: Publication Incentives: Publication productivity emerged as a key mechanism supporting internationalisation. Participants explained that institutions receive financial rewards for high research output, encouraging them to attract internationally experienced academics and researchers who can strengthen publication performance.

"When universities publish very well in South Africa, they actually get more funding. So this also encourages them to seek diverse nationalities that can enhance their publication profiles."

Sub-theme 1.3: Government-Incorporated Strategies

The findings further suggest that many internationalisation initiatives originate from national policy directives. Universities align their recruitment and research strategies with government expectations regarding performance and academic excellence.

"The strategy was actually incorporated from the government."

These findings show that internationalisation is not only institutionally driven but is embedded within a policy framework that uses funding incentives to encourage universities to engage globally through enhanced research productivity and international participation.

Theme 2: International Recruitment and Mobility of Academic Talent

This theme reflects the deliberate recruitment of international students, researchers, and academics as a key strategy for internationalisation.

Sub-theme 2.1: International PhD Recruitment

Recruiting doctoral students from across Africa and other regions emerged as one of the most common internationalisation practices. PhD students contribute to cultural diversity, knowledge exchange, and international research networks.

"They recruited a lot of Ph.Ds all over the world, most especially within African countries."

Sub-theme 2.2: Recruitment of International Postdoctoral Researchers

Participants highlighted the increasing reliance on international postdoctoral researchers, many of whom are foreign nationals. These researchers enhance research capacity and facilitate international collaboration.

"There are some universities that specialise in the recruitment of postdocs, who these days are 90% foreigners."

Sub-theme 2.3: Direct Recruitment of International Faculty

South African universities also recruit academic staff directly from other countries, including Asia, Europe, and North America. This strategy introduces diverse expertise, strengthens global networks, and enriches teaching and research environments.

"They also recruit faculties directly from outside the continent... Asia, China, United States, United Kingdom, etc."

The findings show that internationalisation is operationalised through the strategic recruitment of international human capital at multiple academic levels, including doctoral students, postdoctoral researchers, and faculty members. This approach promotes global knowledge exchange, enhances research quality, and strengthens international institutional linkages. The findings indicate that the internationalisation of higher education in South Africa is mainly pursued through government-driven funding and performance incentives, as well as the strategic recruitment of international doctoral students, postdoctoral researchers, and faculty members. These strategies enhance research productivity, diversify academic communities, foster global collaboration, and strengthen the international competitiveness of South African universities. The findings are further illustrated in the Thematic mapping in Figure 2.

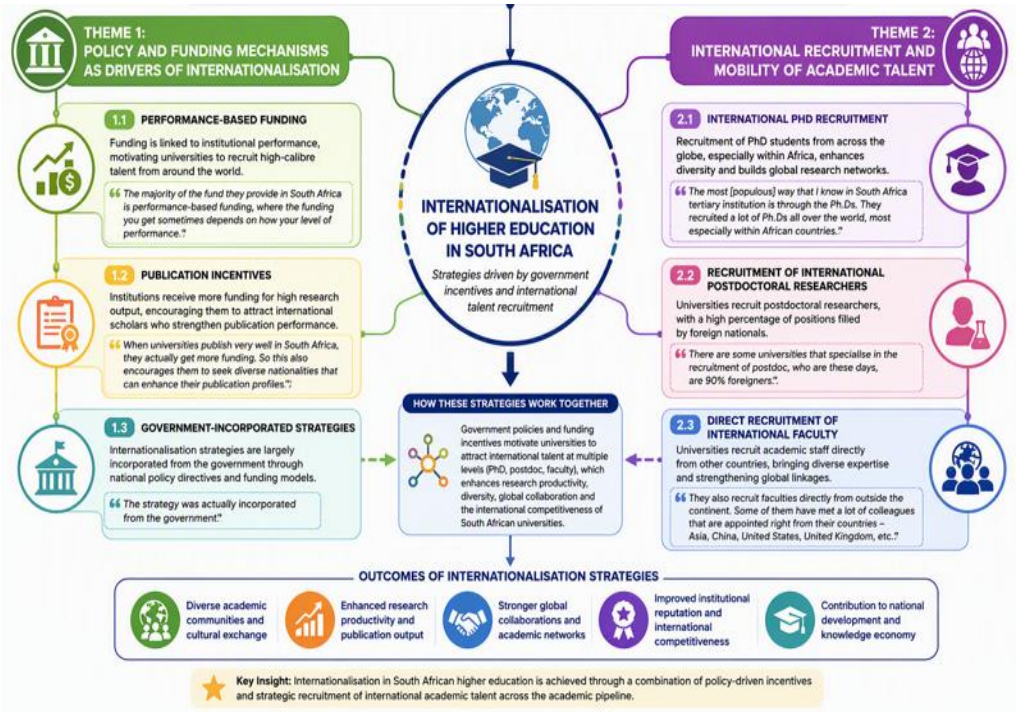


Figure 2: Thematic mapping of strategies for the internationalisation of higher education in South Africa

The thematic map reveals that the internationalisation of higher education in South Africa is driven by the interaction between policy and funding mechanisms, as well as by international recruitment of academic talent. The first theme, Policy and Funding Mechanisms as Drivers of Internationalisation, demonstrates how government policies create incentives for universities to engage globally. The literature indicates that internationalisation has become a strategic response to globalisation, with universities seeking to improve educational quality, research productivity, and global competitiveness through cross-border engagement (Shen et al., 2022; Suntharalingam, 2024). The performance-based funding and publication incentives identified by participants align with the broader objective of enhancing institutional visibility and academic excellence through international collaboration and knowledge exchange. The second theme, International Recruitment and Mobility of Academic Talent, reflects the practical implementation of internationalisation through the recruitment of international PhD students, postdoctoral researchers, and faculty members. According to the literature,

internationalisation involves the cross-border movement of students and academics, participation in global research networks, and institutional partnerships that facilitate knowledge transfer and capacity building (Shen et al., 2022; Jowi, 2024). Such recruitment enhances research output, cultural diversity, and academic quality while strengthening international networks. Furthermore, South Africa's policy frameworks and its status as a regional higher education hub support these recruitment efforts, enabling universities to attract talent from across Africa and beyond (Banda & Zungu, 2024). Together, these themes demonstrate that internationalisation is a policy-supported and talent-driven strategy for achieving global competitiveness and academic excellence.

Research Question 2: What are the opportunities of the internationalisation of higher education in South Africa?

The analysis of participants' responses reveals that the internationalisation of higher education in South Africa presents significant opportunities for expanding research collaboration, enhancing academic mobility through technology, strengthening regional partnerships, and improving policy environments that support global engagement. Two overarching themes emerged from the data.

Theme 1: Enhanced Global and Regional Research Collaboration

This theme reflects the opportunities created by international and regional partnerships that facilitate collaborative research, access to funding, and knowledge exchange.

Sub-theme 1.1: Funding Opportunities for International Research

Participants highlighted South Africa's ability to fund research projects that extend beyond national borders. Such funding promotes multinational research partnerships and increases the international visibility of South African scholarship.

"In South Africa, I have seen a project funded by NRF, but it's been implemented in other countries."

This finding aligns with the literature, which suggests that internationalisation facilitates research collaborations and knowledge sharing between institutions across different countries. Through global partnerships, universities gain access

to diverse expertise, research resources, and innovation opportunities (Jowi, 2024).

Sub-theme 1.2: Regional Cooperation and Academic Partnerships

Participants emphasised opportunities for collaboration between South African universities and institutions across Africa. Such collaborations strengthen regional integration, academic networking, and research capacity.

"Some countries provide funding that is even extended to other countries to do research."

The literature similarly notes a growing emphasis on intra-African academic collaboration through regional initiatives such as the Southern African Development Community (SADC) and the African Union, which promote academic mobility, research networks, and curriculum harmonisation (Kabeya et al., 2022; SADC, 2022).

This theme demonstrates that internationalisation provides South African universities with opportunities to establish regional and global research networks, attract collaborative funding, strengthen research capacity, and expand the impact of their scholarship beyond national boundaries.

Theme 2: Flexible Academic Mobility and Institutional Development: This theme captures opportunities created through technology-enhanced mobility, alternative academic appointments, and policy improvements that facilitate international engagement.

Sub-theme 2.1: Leveraging Technology for Virtual Internationalisation

Participants noted that technological advancements enable academics to contribute to South African higher education without being physically present in the country.

"For example, you can be employed as a postdoc. You can be employed as a research fellow, when you will not need to live in the country."

This finding supports literature arguing that technological developments and digital platforms have become important enablers of internationalisation, facilitating virtual collaboration, online research partnerships, and cross-border knowledge exchange (Mugimu, 2022; Oladele, 2024).

Sub-theme 2.2: Research Fellowships and Proxy Appointments

Participants described opportunities for international scholars to engage with South African institutions through flexible appointments such as research professorships and fellowships.

"You can be appointed as a Research Professor, which can be a proxy appointment."

These arrangements provide mechanisms for international academic engagement while reducing geographical barriers. Such opportunities contribute to knowledge transfer, institutional capacity building, and the development of international research communities (Jowi, 2024).

Sub-theme 2.3: Policy Reforms as Enablers of Internationalisation

Participants suggested that policy reform offers further opportunities to strengthen internationalisation by addressing barriers that currently limit international engagement.

"The majority of these challenges that I'm talking about are not the challenges that any policy has taken care of."

Literature similarly highlights the importance of policy frameworks in fostering academic mobility, research collaboration, and international partnerships. South Africa has already developed extensive policy frameworks to guide internationalisation, and further reforms could expand these opportunities (Banda & Zungu, 2024). The analysis reveals that the internationalisation of higher education in South Africa is achieved through a combination of policy-driven incentives and strategic international recruitment practices. Government funding mechanisms, particularly performance-based funding and publication rewards, create institutional motivations for international engagement. In response, universities actively recruit international PhD students, postdoctoral researchers, and academic staff to enhance research productivity, diversify institutional cultures, and strengthen global academic networks. These interconnected strategies position internationalisation as both a national policy objective and an institutional strategy for academic excellence. The findings are further illustrated in the Thematic mapping in Figure 3.

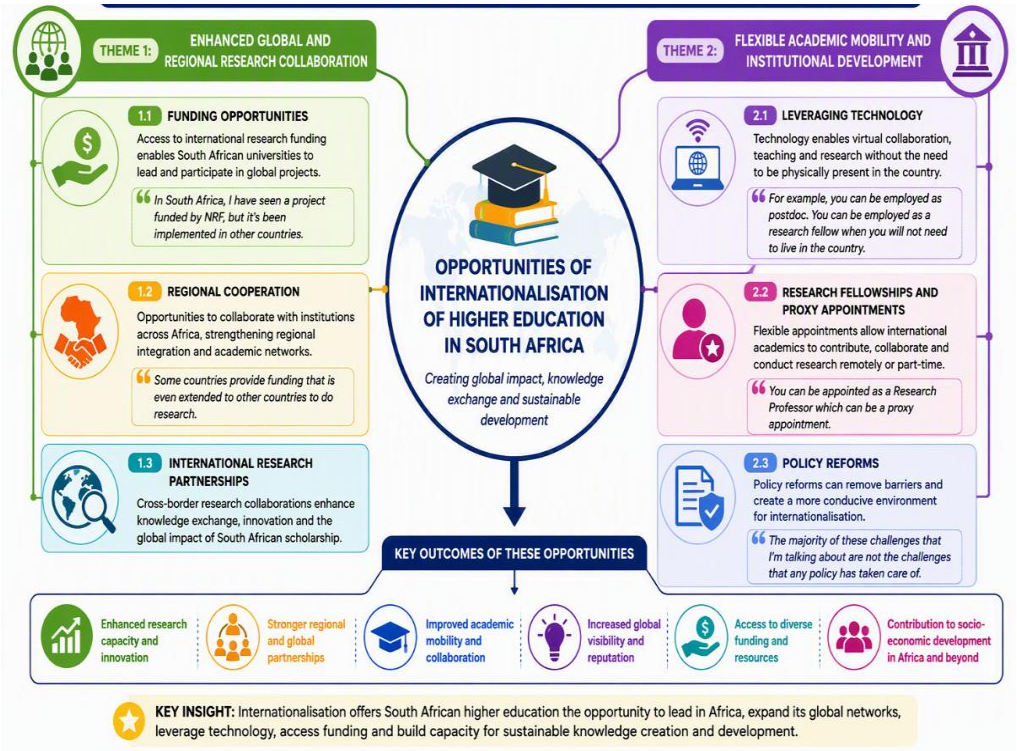


Figure 3: Thematic mapping of the opportunities for the internationalisation of higher education in South Africa

The thematic map illustrates that the opportunities associated with the internationalisation of higher education in South Africa are centred on enhanced research collaboration, flexible academic mobility, and institutional development. The first theme highlights how internationalisation creates opportunities for research funding, regional cooperation, and cross-border academic partnerships. The literature review emphasises that internationalisation enables universities to engage in collaborative research, student and faculty mobility, and institutional partnerships that enhance academic quality, global visibility, and competitiveness. These collaborations support knowledge exchange, curriculum development, and access to global research networks (Shen et al., 2022; Suntharalingam, 2024). Furthermore, partnerships with international institutions facilitate knowledge transfer, skill development, capacity building, and access to advanced research resources and technological innovations (Moshtari & Safarpour, 2024; Jowi, 2024). The second theme demonstrates how technology, research fellowship programmes, proxy appointments, and policy reforms expand opportunities for international

engagement. The literature notes that technological advancement is a major driver of internationalisation in higher education, enabling virtual collaboration and academic participation across borders (Mugimu, 2022; Oladele, 2024). In addition, regional initiatives such as the African Union's Continental Education Strategy and SADC frameworks promote academic mobility, research networking, and institutional cooperation across Africa (Kabeya et al., 2022; SADC, 2022). South Africa's extensive internationalisation policy frameworks further strengthen these opportunities and position the country as a leading higher education hub on the continent (Banda & Zungu, 2024). This theme suggests that internationalisation is increasingly facilitated by technological innovation and institutional flexibility, creating opportunities for broader participation in global knowledge networks while reducing traditional mobility constraints. Collectively, the thematic map demonstrates that internationalisation offers South African universities opportunities for research excellence, global partnerships, technology-enabled collaboration, capacity building, and sustainable institutional development.

Research Question 3: What are the challenges of the internationalisation of higher education in South Africa?

The analysis of participants' responses reveals that the internationalisation of higher education in South Africa is constrained by social exclusion and inequality, as well as institutional and structural barriers. Two overarching themes emerged from the data.

Theme 1: Social Exclusion and Barriers to International Academic Integration: This theme captures the social and institutional challenges faced by international academics and students in South African higher education institutions.

Sub-theme 1.1: Discrimination Against International Academics and Students: Participants reported that foreign academics and students often experience difficulties integrating into university environments and communities. These challenges affect their sense of belonging and ability to participate fully in academic life.

"Discrimination in the sense that the majority of foreign people find it difficult to acclimatise themselves, or some universities find it difficult to welcome them."

Literature similarly identifies cultural and social barriers as significant obstacles to internationalisation. Language differences, cultural exclusion, and limited inclusivity can hinder effective collaboration and mobility within higher education systems (Msomphora, 2025; Murove, 2018).

Sub-theme 1.2: Systematic Xenophobia and Institutional Barriers: Participants highlighted the existence of institutional practices and policies that disadvantage foreign academics despite their contributions and performance. These experiences suggest the presence of systemic inequities within some institutions.

“There are some policies. There are some artificial policies you find in some of these organisations. That actually worked against you…”

The literature review supports this concern by noting that unequal institutional structures and asymmetrical relationships often limit fair participation and decision-making opportunities for some groups within international collaborations (Molosi-France & Makoni, 2020). This theme suggests that while internationalisation promotes global engagement, discriminatory practices and xenophobic tendencies can undermine its objectives by restricting inclusion, diversity, and equitable participation.

Theme 2: Structural and Institutional Constraints to Internationalisation: This theme reflects challenges associated with resources, infrastructure, funding disparities, talent retention, and unequal international partnerships.

Sub-theme 2.1: Brain Drain and Loss of Academic Talent

Participants described the departure of highly skilled international academics from South Africa in search of better opportunities elsewhere.

“These challenges have sent so many foreign lecturers away from the country.”

This finding aligns with the literature identifying brain drain as a major challenge facing African higher education. The migration of talented academics weakens institutional research capacity and limits universities' ability to sustain quality education and innovation (Scholarworks & Osigbesan, 2021).

Sub-theme 2.2: Funding Inequality

Participants noted substantial differences in salaries, publication incentives, and institutional resources among universities. These disparities affect the capacity of some institutions to attract and retain international talent.

"There are variations in salaries. There are variations in how universities compensate publications."

The literature identifies inadequate funding and resource constraints as major barriers to internationalisation across African universities (Mugimu, 2022).

Sub-theme 2.3: Limited Infrastructure

Participants observed that while some South African universities possess world-class facilities, others lack adequate infrastructure to support internationalisation initiatives.

"There are some universities that are infrastructurally superb in South Africa. There are some that are deficient…"

This finding resonates with studies highlighting infrastructural limitations and technological disparities as obstacles to international engagement and research collaboration (Oladele, 2024; Mugimu, 2022).

Sub-theme 2.4: Inequality in International Collaboration

Participants further indicated that some international partnerships are unequal, with foreign institutions often benefiting more from collaborations than local universities.

"Some of those collaborations we sought for outside the continent…"

The literature similarly argues that collaborations between African universities and institutions in the Global North can be asymmetrical, resulting in unequal power relations and limited local control over research agendas (Molosi-France & Makoni, 2020). This theme demonstrates that internationalisation is constrained by resource disparities, infrastructure deficiencies, unequal partnerships, and the continued loss of skilled academics. These challenges limit universities' ability to maximise the benefits of global engagement. The findings reveal that the challenges of internationalising higher education in South Africa stem from both social exclusion and institutional constraints. Discrimination, xenophobia, and difficulties in integrating international academics undermine inclusivity and diversity within universities. At the same

time, brain drain, funding inequalities, inadequate infrastructure, and unequal international collaborations restrict the effectiveness and sustainability of internationalisation efforts. These findings support the existing literature, which identifies social barriers, resource constraints, unequal global partnerships, and talent migration as major impediments to higher education internationalisation in Africa (Molosi-France & Makoni, 2020; Mugimu, 2022; Scholarworks & Osigbesan, 2021; Msomphora, 2025). The findings are further illustrated in the Thematic mapping in Figure 4.

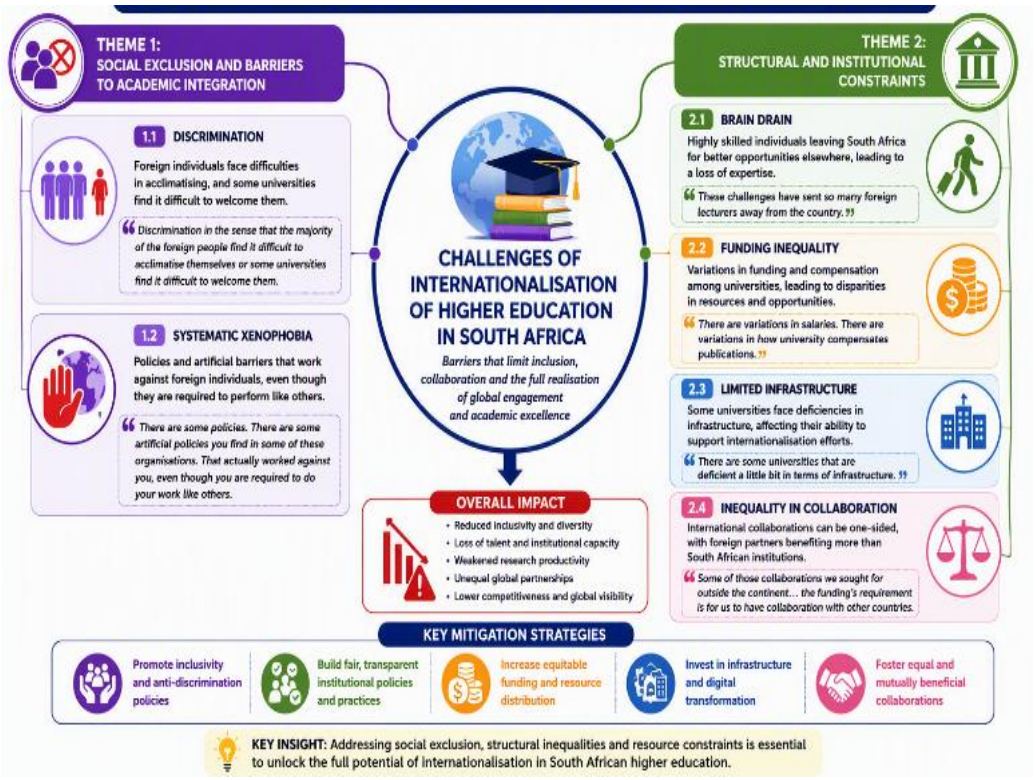


Figure 4: Thematic mapping of the Challenges of internationalisation of higher education in South Africa

The thematic map shows that the challenges of internationalisation in South African higher education operate at both social and structural levels. The first theme, Social Exclusion and Barriers to Academic Integration, encompasses discrimination and systematic xenophobia experienced by international academics and students. These challenges hinder successful integration into university communities and undermine the inclusiveness that internationalisation seeks to promote. The literature review similarly identifies

cultural and linguistic barriers as obstacles to effective internationalisation, noting that differences in language, culture, and institutional practices can limit regional and global cooperation (Msomphora, 2025; Murove, 2018). Furthermore, the literature emphasises that internationalisation should promote cultural exchange and global engagement, but exclusionary practices can restrict these benefits. The second theme, Structural and Institutional Constraints, comprises brain drain, funding inequality, limited infrastructure, and unequal collaborations. Participants reported that skilled academics often leave South Africa for better opportunities elsewhere, reflecting the broader challenge of brain drain identified in the literature. According to the literature review, brain drain weakens local research capacity and reduces universities' ability to provide quality education and conduct cutting-edge research (Scholarworks & Osigbesan, 2021). The literature also highlights inadequate funding, technological limitations, and asymmetrical partnerships with institutions from the Global North as major barriers to internationalisation (Mugimu, 2022; Oladele, 2024; Molosi-France & Makoni, 2020). Together, these challenges reduce institutional competitiveness, limit equitable participation in global knowledge production, and constrain the full realisation of internationalisation goals in South African higher education

Conclusion

Therefore, the study concludes that South Africa remains one of Africa's leading hubs for higher education internationalisation, with considerable potential to advance research collaboration, academic mobility, and institutional development. However, achieving the full benefits of internationalisation requires deliberate efforts to address social exclusion, strengthen institutional capacity, promote equitable partnerships, and create supportive policy environments for international scholars. Addressing these challenges will not only enhance South Africa's global competitiveness but also contribute to the broader development of higher education across the African continent.

Recommendations

The following recommendations are given to help South Africa maximise the opportunities offered by internationalisation while addressing the social and structural challenges that currently limit its effectiveness.

1. Strengthen inclusive institutional policies and support systems for international academics and students: South African universities should develop and implement comprehensive institutional policies that address discrimination, xenophobia, and barriers to integration faced by international academics and students. Such policies should include diversity and inclusion programmes, intercultural awareness training, mentorship schemes, and transparent recruitment, promotion, and remuneration practices. Creating a welcoming and supportive academic environment will enhance the retention of international talent, promote equitable participation, and strengthen multicultural learning experiences central to internationalisation. Addressing social exclusion will also help universities realise the full benefits of international collaboration, knowledge exchange, and global engagement.
2. Enhance equitable funding, infrastructure development, and collaborative partnerships: The government and higher education institutions should invest in reducing funding disparities and improving infrastructure across universities to support sustainable internationalisation. Increased investment in digital technologies, research facilities, and virtual collaboration platforms would expand access to international opportunities and strengthen institutional competitiveness. In addition, universities should pursue mutually beneficial international partnerships that promote shared decision-making, equitable resource distribution, and local research leadership. Such measures would reduce the effects of brain drain, strengthen research capacity, and ensure that international collaborations contribute meaningfully to national and continental development.

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CHAPTER TWENTY-NINE
Beyond the Credit Hour: Aligning Nigerian Graduate Education with Global Standards for Rigorous Research

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Abstract

The debate about Nigerian graduate education is often framed as a choice between credit-hour programmes and research-intensive training. This policy analysis argues that the credit hour is not a cause of weak research performance. It is an administrative measure of student workload that coexists with productive doctoral systems, including the United States. The policy problem is how coursework, supervision, funding, infrastructure, research integrity, milestones, and programme accountability are configured and implemented. Using a structured comparative review of policy documents, statistical reports, quality codes, and peer-reviewed studies published from 2021 to July 2026, the paper compares Nigeria with the United States, the United Kingdom, Germany, India, South Africa, Brazil, and African Centres of Excellence. Evidence shows that successful systems combine coursework with research immersion, accountable supervision, funded research environments, external examination, progress review, transferable-skills development, and programme-level evaluation. Nigerian evidence links low productivity more strongly to inadequate funding, limited research time, weak mentorship, deficient facilities, and fragmented research support than to credit accounting. The paper therefore proposes a dual architecture: retain credits for taught and transferable skills components, but make progression and graduation dependent on verified research competencies and milestone completion. Recommended reforms include a national graduate research quality framework, doctoral schools, supervisor accreditation and workload limits, student and project funding, shared research infrastructure, digital repositories, external examination, programme data dashboards, and phased performance-based review. Nigeria should move beyond treating credits as sufficient evidence of doctoral quality, rather than eliminating credit hours. Alignment with global standards requires research ecosystems, transparent governance, and enforceable outcomes.

Keywords: Graduate education, Credit hour, Research quality, Policy analysis.

Introduction

Graduate education is a central component of a national research and innovation system. It prepares advanced professionals, renews the academic workforce, supports public policy, and produces knowledge that can be translated into social and economic value. The global environment in which graduate education now operates has become more demanding. Research is increasingly collaborative, data-intensive, interdisciplinary, digitally mediated, and evaluated through explicit standards for integrity, reproducibility, societal relevance, and international visibility. Comparative education reporting also places doctoral education within wider systems of financing, participation, mobility, and labour-market outcomes (Organisation for Economic Co-operation and Development [OECD], 2024). UNESCO reported that global research expenditure increased by 19.2% between 2014 and 2018 and that the worldwide researcher population grew by 13.7%, although research capacity remained highly concentrated and 80% of countries still invested less than 1% of gross domestic product in research and development (UNESCO, 2021). These inequalities mean that graduate reform in Nigeria must address the institutional conditions under which research is undertaken, not only the formal structure of curricula.

The reviewed version of this article correctly identified important weaknesses in Nigerian postgraduate education, including inadequate funding, weak supervision, deficient laboratories and libraries, limited international exposure, fragmented governance, and the migration of experienced academics. Its central weakness, however, was the treatment of the credit-hour system as the primary cause of low research quality. That argument cannot be sustained comparatively. Credit hours are used in the United States, where universities awarded 57,862 research doctorates in 2023 and 79% of those doctorates were in science and engineering fields (National Center for Science and Engineering Statistics [NCSES], 2024). A credit-based system can therefore coexist with extensive research infrastructure, funded assistantships, rigorous candidacy procedures, original dissertations, external scholarly scrutiny, and strong publication cultures.

The relevant distinction is between an administrative unit and a quality-assurance architecture. A credit hour records an estimated volume of student work. It does not determine whether a doctoral candidate receives adequate supervision, has access to laboratories or data, completes defensible research milestones, follows ethical and open-science practices, or produces an original contribution. Current United States guidance defines a credit hour as an institutionally determined amount of student work approved through accreditation and expressly allows institutions to set higher standards or use other academic measures for non-federal purposes (U.S. Department of Education, 2025). Consequently, the policy question is not whether Nigeria should abolish credit hours. It is whether credits have been allowed to function as a substitute for evidence of research competence and whether the wider research ecosystem supports rigorous inquiry.

This article retains the original concern with global alignment but reframes the diagnosis. It argues that weak research performance is better explained by implementation failure and ecosystem constraints than by the existence of credits. It then uses recent comparative evidence to identify the institutional arrangements that make research-intensive graduate education possible. The resulting proposal is a dual architecture in which credits remain useful for taught components, while research progression and graduation are governed by competencies, milestones, independent assessment, and programme-level accountability.

Aim and Policy Questions

The aim of this policy analysis is to develop an empirically grounded framework for aligning Nigerian graduate education with current global standards for rigorous research without attributing research weakness to the credit-hour system itself. The analysis addresses four questions. First, what does comparative evidence show about the relationship between credit-based curricula and research-intensive doctoral education? Second, which institutional factors most plausibly constrain research quality and productivity in Nigeria? Third, which policy mechanisms used in other national systems are transferable to the Nigerian context? Fourth, how can Nigeria implement reform in a phased, financially realistic, and accountable manner?

Methodology

This article is a comparative policy analysis based on a structured review of recent secondary evidence. It is not presented as a systematic review or meta-analysis, and it does not report original survey or interview data. The method was designed to improve transparency, analytical discipline, and reproducibility while remaining appropriate for a policy paper.

The evidence searches covered publications issued from January 2021 to 28 July 2026. Targeted searches were conducted through official government and regulatory portals, international organisation repositories, university-sector bodies, and accessible peer-reviewed publisher platforms. Search terms combined the concepts doctoral education, graduate research quality, credit hour, doctoral supervision, research funding, programme evaluation, research integrity, Nigeria, United States, United Kingdom, Germany, India, South Africa, Brazil, and African Centres of Excellence. Sources were included when they met four criteria: publication within the stated period; direct relevance to doctoral governance, research training, supervision, funding, infrastructure, assessment, or quality assurance; institutional authority or transparent empirical methods; and online accessibility sufficient for verification. Opinion pieces without a disclosed evidence base, sources published before 2021, duplicate reports, and documents concerned only with undergraduate teaching were excluded.

The final evidence base comprised 16 sources: two peer-reviewed empirical studies focused on Nigerian research conditions and fourteen official, statistical, regulatory, or sector reports from national and international organisations. Countries were selected purposively to represent different governance models and levels of development. The United States provides a direct counterexample to the claim that credit hours prevent research intensity. The United Kingdom and Germany illustrate funded doctoral training and institutional quality frameworks. India demonstrates the combination of minimum coursework credits with research advisory committees and recurring progress review. South Africa provides an African system with national doctoral statistics and qualification standards. Brazil illustrates programme-level periodic evaluation. The World Bank-supported African Centres of Excellence provide a regional example of concentrated investment, accreditation, mobility, and research output.

Analysis proceeded in three stages. First, the Nigerian problem was disaggregated into inputs, processes, outputs, and governance. Inputs included finance, facilities, databases, staffing, and researcher time. Processes included supervision, methods training, ethics, milestone review, collaboration, and examination. Outputs included theses, publications, completion, research impact, and graduate destinations. Governance included regulation, programme approval, data reporting, incentives, and accountability. Second, comparable mechanisms were extracted from each international case. Third, those mechanisms were assessed for relevance, feasibility, equity implications, and compatibility with Nigeria's existing university and TETFund structures.

The method has limitations. National systems are internally diverse, reported statistics are not always based on identical definitions, and policy documents may describe formal expectations more clearly than actual practice. Causal claims are therefore made cautiously. International arrangements are treated as policy options rather than templates for direct transplantation. The analysis identifies plausible mechanisms supported by comparative evidence, but local pilots and subsequent evaluation are required before nationwide implementation.

Reframing the Policy Problem: Beyond a False Choice

A credible reform argument must distinguish three concepts that were previously conflated: credits, coursework dominance, and research quality. Credits quantify learning volume. Coursework dominance describes a programme design in which taught modules occupy disproportionate time or carry most progression consequences. Research quality concerns the originality, methodological robustness, integrity, transparency, and significance of scholarly work. These concepts can interact, but they are not interchangeable.

The United States makes the distinction clear. Federal guidance defines credits primarily for workload and student-aid purposes, while institutions and accreditors determine programme requirements and may impose higher or alternative academic standards (U.S. Department of Education, 2025). Research doctorates are separately defined through the expectation of an original intellectual contribution and a dissertation or equivalent research product. The scale of United States doctoral production, including 57,862 research doctorates in 2023, demonstrates that credit accounting does not

preclude research intensity (NCSES, 2024). The decisive variables are the resources, incentives, supervision, admissions standards, research culture, and assessment mechanisms surrounding the credits.

India offers a second counterexample. Its 2022 doctoral regulations require a minimum of 12 credits of coursework, including research methodology and research and publication ethics. At the same time, every scholar must have a Research Advisory Committee, present progress each semester, undergo plagiarism screening, and submit the thesis to external evaluation (University Grants Commission [UGC], 2022). The policy combines credits and research milestones rather than treating them as substitutes. South Africa similarly expresses qualifications through credit values, including doctoral qualifications, while national standards and institutional processes govern the level and quality of research. In 2023, South African public universities enrolled 25,475 doctoral students and produced 3,620 doctoral graduates, with a proxy doctoral graduation rate of 14.2% (Department of Higher Education and Training [DHET], 2025). These examples disprove a general structural claim against credits.

The problem in Nigeria is more precise. Credits may become harmful when institutions count course completion as sufficient evidence of graduate quality, when research is deferred until late in the programme, or when students receive credits for nominal seminars and methods courses without demonstrating competence. In such circumstances, the failure lies in programme design and implementation. Eliminating credits without correcting funding, supervision, infrastructure, research integrity, and accountability would change the unit of measurement while leaving the production system intact.

A stronger theoretical position is therefore ecosystem-based. Research quality is produced through the interaction of adequate inputs, well-designed processes, credible assessment, and accountable governance. Under this model, the expected effect of credits is conditional rather than causal. Credits can support quality when they are attached to substantive methods training, laboratory rotations, fieldwork, data stewardship, ethics, academic writing, and transferable skills. They can weaken the quality when they reward attendance or examination performance without authentic research tasks. The reform objective should be to limit the evidentiary role of credits and strengthen direct evidence of research capability.

Empirical Diagnosis of Nigerian Graduate Research

Recent Nigerian evidence supports an ecosystem diagnosis. Igiri et al. (2021) surveyed 2,350 academics and researchers across 66 universities, research institutes, and polytechnics in Nigeria's six geopolitical zones. Among the challenges reported by respondents, 42.98% identified a lack of research funding, 17.11% identified brain drain, and 8.85% identified a lack of motivation. More than half of the respondents reported publishing at least one article only once every two years. Although the study relied partly on self-reported data and covered researchers beyond postgraduate programmes, its national spread and sample size provide a more credible basis for policy discussion than unsupported generalisation.

A complementary study of social science research found that Nigeria has a substantial research community and produces a meaningful volume of peer-reviewed work, but that output remains below the country's potential because inputs, research time, institutional support, and coordination are weak (Egbetokun et al., 2022). This finding is analytically important. It shows that the problem is not an absence of scholarly capacity. It is the system's low efficiency and uneven quality that convert human talent into sustained, visible, and societally useful research.

Funding and Research Time

Research-intensive graduate education requires predictable funding at three levels: the candidate, the project, and the institution. Candidate funding supports living costs and protects time for research. Project funding pays for data collection, laboratory materials, fieldwork, software, dissemination, and ethical compliance. Institutional funding maintains laboratories, libraries, research offices, repositories, grant-management systems, and technical staff. Nigerian interventions have often focused on discrete grants or infrastructure projects, without consistently financing the full research pathway. A laboratory cannot produce high-quality theses if reagents are unavailable, equipment is not maintained, supervisors are overloaded, and candidates work full-time elsewhere to finance their studies.

The global context makes this deficiency consequential. UNESCO (2021) showed that research expenditure and researcher numbers were expanding worldwide, but resources remained concentrated in a small group of economies. Nigerian universities, therefore, compete in an environment where

well-funded systems can provide doctoral stipends, research assistants, laboratory technicians, data specialists, and publication support. The issue is not that every Nigerian programme must replicate the expenditure of a wealthy research university. It is that programmes should admit candidates only when the minimum resources for the proposed research can be demonstrated.

Supervision, Mentorship, and Workload

Supervision is the principal mechanism through which doctoral standards are interpreted in practice. Weakness arises when supervisory appointments are based only on rank, when workloads are uncapped, when feedback is delayed, or when a single supervisor controls progression without review. The Nigerian evidence on lack of mentorship and limited research support is consistent with this concern (Igiri et al., 2021). The problem is intensified by academic migration, uneven distribution of senior researchers across institutions and disciplines, and the absence of routine supervisor development.

Research-intensive systems increasingly treat supervision as an institutional responsibility rather than a private relationship. European doctoral policy now emphasises structured supervision, candidate support services, and career development within doctoral schools and programmes (Marti & Peneoasu, 2025). India requires a committee for each scholar rather than relying exclusively on one supervisor, while semester progress presentations create a documented opportunity for correction (UGC, 2022). Nigeria can adapt these mechanisms through co-supervision, supervisory panels, workload limits, and escalation procedures that protect both candidates and standards.

Infrastructure, Data, and Digital Research Capacity

The original article correctly identified outdated laboratories, weak library access, unstable connectivity, and limited access to journals and databases. These conditions affect different disciplines differently. Laboratory sciences require equipment, consumables, safety systems, and calibration. Social sciences require reliable data access, fieldwork funding, software, and secure data management. Humanities require archives, digitised collections, and research libraries. Across disciplines, candidates now require reference management, statistical or qualitative analysis tools, research data management, cybersecurity, and responsible use of artificial intelligence.

Infrastructure policy should therefore move from isolated procurement to lifecycle management. Procurement decisions should include utilisation plans,

technical staffing, maintenance contracts, power requirements, consumables, user access rules, and performance reporting. Shared regional facilities are preferable where sophisticated equipment would be underused by a single institution. Digital repositories and persistent researcher identifiers can also improve discoverability, reduce duplication, and preserve theses and datasets.

Research Integrity and Assessment

A thesis can satisfy formal length and formatting requirements while remaining methodologically weak. Quality assurance must therefore examine the research process, not only the final document. Minimum safeguards include approved protocols, ethics review where applicable, data-management plans, documented analysis, originality screening, transparent use of artificial intelligence, pre-submission seminars, and independent examination. Publication requirements should be used cautiously. Requiring an article can encourage scholarly communication, but a rigid rule may also drive candidates toward predatory journals or superficial salami publication. The stronger standard is a defensible original contribution assessed by competent independent experts, with publication support and journal-quality guidance.

Current global frameworks increasingly combine institutional responsibility with external scrutiny. The 2024 UK Quality Code frames academic standards and quality enhancement as responsibilities that providers must evidence through coherent processes (Quality Assurance Agency for Higher Education [QAA], 2024). Brazil's CAPES system evaluates graduate programmes periodically and publishes programme ratings, connecting programme performance with national oversight rather than leaving quality to individual theses alone (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior [CAPES], 2026). Nigeria requires a comparable shift from episodic accreditation toward continuing programme evidence.

Governance, Incentives, and Data Deficits

Fragmented responsibility weakens implementation. The National Universities Commission regulates programme standards, TETFund finances major interventions, universities control admissions and supervision, professional bodies influence some disciplines, and external examiners assess theses. These roles are individually legitimate but are not always connected through a shared graduate research performance framework. Consequently, the system lacks a consistent national dataset on doctoral admissions, funding status, supervisory

loads, time to degree, attrition, examination outcomes, publications, research integrity cases, employment destinations, and international collaboration.

Incentives also matter. When promotion systems reward publication counts without sufficient attention to quality, academics may prioritise volume. When departments receive reputational benefits from enrolment and completion but bear few consequences for attrition or poor examination, throughput can dominate. When candidates pay fees for extended periods, institutions may have conflicting incentives regarding timely completion. Policy reform must align incentives with credible outputs, ethical conduct, timely completion, and demonstrable societal or scholarly contribution.

Comparative Policy Evidence and Transferable Lessons

United States: Credit Accounting Plus Research Intensity

The United States is the most important comparator because it directly contradicts the claim that credit hours inherently undermine doctoral research. Credits are widely used, but doctoral quality is built through selective admission, funded research groups, laboratory or field immersion, qualifying examinations, candidacy, dissertation committees, research assistantships, and an original dissertation. NCSES data show both the scale and disciplinary breadth of the system: 57,862 research doctorates were awarded in 2023, and 79% were in science and engineering (NCSES, 2024). The lesson for Nigeria is not to copy a decentralised American model wholesale. It is to recognise that workload metrics and research standards perform different functions. Nigerian regulation should state explicitly that credit completion is necessary only for specified taught components and is never sufficient for the award of a research degree.

United Kingdom and Europe: Quality Codes, Doctoral Structures, and Career Development

The United Kingdom combines institutional autonomy with sector-wide reference points. The 2024 UK Quality Code articulates principles for securing academic standards and enhancing quality, while UK Research and Innovation reorganised doctoral funding around focal and landscape awards and announced more than £500 million for doctoral studentships in 2024 (QAA, 2024; UK Research and Innovation [UKRI], 2024). The funding model is linked to expectations for recruitment, training, research outcomes, and wider professional development.

Across Europe, doctoral schools have become important organisational structures for supervision, training, candidate services, mobility, and career development. European sector reviews emphasise structured doctoral provision, supervisory practice, candidate support services, and preparation for diverse careers rather than treating the doctorate as an isolated apprenticeship (European University Association, 2022; Marti & Peneoasu, 2025). Nigeria can adopt the organisational logic of doctoral schools without creating expensive new bureaucracies. A doctoral school can be a coordinated institutional platform that provides common methods courses, ethics training, data support, supervisor development, milestone monitoring, and international partnerships across faculties.

Germany: Concentrated Funding and Structured Research Training

Germany's Research Training Groups demonstrate how competitive funding can build cohorts around defined research themes. In 2024, the German Research Foundation approved 17 new groups with approximately EUR123 million for an initial five-year period and reported funding 214 groups in total, including 26 international groups (Deutsche Forschungsgemeinschaft [DFG], 2024). These groups combine high-level disciplinary research with structured training and, in some cases, international partners. The transferable lesson is the value of concentration. Rather than dispersing limited funds across every department, Nigeria should fund competitive thematic doctoral clusters with clear staffing, infrastructure, candidate support, and output commitments.

India: Credits Combined with Advisory Committees and Milestones

India's 2022 regulations show that coursework credits can be retained while research governance is strengthened. The framework requires at least 12 coursework credits, including research methodology and research and publication ethics. It also creates a Research Advisory Committee for every doctoral scholar, requires semester progress presentations, mandates integrity screening, and provides for external thesis evaluation (UGC, 2022). This combination is directly relevant to Nigeria because both systems include large, diverse higher education sectors and uneven institutional capacity. The practical lesson is to attach credits to demonstrable competencies while making progression dependent on committee-reviewed research milestones.

South Africa: National Statistics and Qualification-Level Accountability

South Africa provides a regional comparator with a differentiated university system and formal qualification standards. Public universities enrolled 25,475 doctoral students and awarded 3,620 doctorates in 2023. The reported proxy graduation rate for doctoral qualifications was 14.2% (DHET, 2025). These data do not prove quality by themselves, but their regular publication makes system performance visible and supports planning. Nigeria's immediate lesson is the need for a national graduate education data system that reports enrolment, completion, field, gender, institution, funding, and time-to-degree using stable definitions.

Brazil: Periodic Programme Evaluation

Brazil's CAPES model evaluates stricto sensu graduate programmes through disciplinary committees and periodic national review. Results of the 2021-2024 evaluation were published in 2026, with programme scores, reconsideration procedures, and public reporting mechanisms (CAPES, 2026). The central policy insight is that quality should be assessed at the programme level, not inferred solely from institutional accreditation or individual thesis examination. A programme that repeatedly shows excessive attrition, weak outputs, inadequate supervision, or integrity failures should enter improvement status, face reduced admissions, or lose approval.

African Centres of Excellence: Regional Scale and Accountable Investment

The African Centres of Excellence programme demonstrates that research capacity can be built within African universities when investment, specialisation, regional collaboration, accreditation, and measurable outputs are connected. By 2025, the programme had established more than 80 centres in over 50 universities across 20 countries, enrolled more than 90,000 students, including 7,650 doctoral candidates, supported over 130 internationally accredited programmes, and generated more than 10,350 internationally peer-reviewed publications (World Bank, 2025). These figures are programme-reported and should not be interpreted as an independent causal evaluation. They nevertheless show the scale that can be achieved through concentrated, monitored, cross-border investment. Nigeria should expand participation in such networks and apply similar accountability to nationally funded centres.

A Policy Framework for Nigeria

The evidence supports a reform strategy that moves beyond the credit hour as the dominant proof of academic progress while retaining it where it remains useful. The proposed model has two connected layers. The taught layer uses credits for advanced theory, research methods, ethics, data analysis, academic writing, pedagogy, innovation, and professional skills. The research layer uses verified milestones and competencies. No candidate should graduate because a prescribed number of credits has been accumulated. Graduation should require an independently examined original contribution and a documented record of responsible research practice.

National Graduate Research Quality Framework

The National Universities Commission, in collaboration with universities, TETFund, professional bodies, research institutes, employers, and doctoral candidates, should establish a National Graduate Research Quality Framework. The framework should specify minimum outcomes rather than impose a uniform curriculum. Required outcomes should include advanced disciplinary knowledge, methodological competence, ethical judgement, data stewardship, capacity to communicate research, ability to situate findings within international literature, and evidence of an original contribution.

The framework should distinguish master's degrees by coursework, professional master's degrees, research master's degrees, professional doctorates, and research doctorates. Different awards require different balances of taught learning and research, but each must have explicit outcome statements. Universities should retain autonomy to exceed the minimum and to design discipline-appropriate routes.

Milestone-Based Progression

Doctoral progression should be organised around a national minimum sequence with room for disciplinary adaptation. The sequence should include: an approved research concept and resource plan at admission; completion of required methods and integrity training; confirmation of candidature after proposal defence; ethics approval where applicable; annual or semester progress review; data or evidence audit; pre-submission seminar; originality and integrity checks; independent external examination; and oral defence where required. Each milestone should have written criteria, a decision record, corrective actions, and an appeal route.

Credits may be attached to methods courses, laboratory rotations, fieldwork preparation, or transferable skills, but milestone decisions should be based on performance. For example, passing a statistical methods course should not substitute for demonstrating that the candidate can select, justify, execute, and interpret an analysis appropriate to the thesis.

Doctoral Schools and Research Clusters

Universities with sufficient scale should establish doctoral schools or equivalent coordinated structures. Smaller institutions should form regional or thematic consortia. These structures should pool methods teaching, integrity training, data services, writing support, grant development, and career preparation. They should also maintain candidate records and intervene when supervision fails.

Competitive national funding should support thematic research clusters in areas linked to Nigeria's scientific, social, cultural, industrial, and policy priorities. Selection should be based on demonstrated supervisory capacity, infrastructure, partnerships, data access, and a credible candidate-support plan. Funding should be multi-year and subject to mid-term review. Concentration is necessary because distributing small amounts to every programme may create formal inclusion without research viability.

Supervisor Accreditation, Teams, and Workload Limits

Supervision should be recognised as specialised academic work. Eligibility should require recent research activity, integrity training, supervision development, and knowledge of institutional procedures. New supervisors should work within teams before serving as principal supervisors. Every doctoral candidate should have at least two supervisors or a supervisor plus an advisory panel, with one member independent of the immediate unit where feasible.

Universities should publish maximum supervisory loads by discipline and degree level. Workload allocation must account for the intensity of laboratory, field, clinical, creative, and data-intensive research. Annual candidate feedback should be reviewed at programme level, not used as the sole measure of supervisor performance. Persistent delay, non-response, conflict of interest, or ethical breach should trigger remediation or suspension of supervisory eligibility.

Funding Reform

TETFund and other public funders should move toward integrated graduate research packages. TETFund's annual reporting provides an institutional base from which more transparent graduate-research funding, utilisation, and outcome reporting can be developed (Tertiary Education Trust Fund [TETFund], 2023). A package may combine a candidate stipend or fee support, project costs, supervisor or technical support, infrastructure access, research dissemination, and institutional indirect costs. Competitive selection should be transparent and should protect equitable access across regions, institutions, disciplines, gender, and disability status.

Funding should be released against verified milestones rather than calendar time alone. Institutions should report expenditure, outputs, delays, and equipment utilisation. Programmes should not admit candidates into resource-intensive projects without a documented funding and facility plan. Private-sector and philanthropic participation should be encouraged, but academic independence, publication rights, conflict-of-interest disclosure, and data governance must be protected.

Shared Infrastructure and Digital Transformation

Nigeria should develop a network of shared research facilities rather than replicate expensive equipment in every university. Each facility should publish access rules, pricing or subsidy arrangements, maintenance status, technical expertise, and utilisation data. National procurement should prioritise interoperability, service contracts, spare parts, power resilience, and technician training.

Every approved doctoral programme should provide access to current scholarly literature, institutional repositories, plagiarism and similarity tools, secure data storage, statistical or qualitative software, and research data management support. Theses should be deposited in interoperable repositories with persistent identifiers, subject to ethical or security restrictions. Open science should be promoted through appropriate data and protocol sharing, while recognising confidentiality, indigenous knowledge rights, commercial sensitivity, and national security.

Internationalisation and Industry Collaboration

Internationalisation should be designed around research value rather than symbolic agreements. Priority mechanisms include joint supervision, cotutelle degrees, visiting scholars, shared seminars, regional methods schools, access to specialised facilities, collaborative grants, and reciprocal mobility. Participation in African research networks should receive equal policy attention with partnerships outside the continent.

Industry and public-sector collaboration can improve relevance, provide data and facilities, and broaden graduate careers. However, industry-linked doctorates require clear agreements on intellectual property, publication, confidentiality, ethics, and candidate assessment. Research questions should remain academically defensible and should not be reduced to consultancy deliverables.

Programme-Level Evaluation and Public Data

Nigeria should introduce a periodic national review of graduate programmes, drawing selectively on Brazil's programme-level evaluation and South Africa's statistical reporting. Evaluation should combine quantitative indicators with peer judgement. Core indicators should include admissions selectivity, funding coverage, supervisory loads, candidate-to-completion progression, time to degree, attrition, examination outcomes, publication quality, research integrity, graduate destinations, international collaboration, societal engagement, and candidate experience.

Indicators must be interpreted by discipline and should not reward raw publication counts. Humanities monographs, creative outputs, policy datasets, patents, clinical guidelines, and community-based outcomes require appropriate recognition. Programme ratings should have consequences. High-performing programmes may receive development grants and expanded admissions. Programmes with correctable deficiencies should enter monitored improvement. Programmes that cannot meet minimum research conditions should suspend admissions until capacity is restored.

Phased Implementation Roadmap

Phase 1: Foundation, 0-2 Years

The first phase should establish definitions, data, and minimum safeguards. The NUC should convene a national working group and issue the Graduate

Research Quality Framework. Universities should map all graduate programmes, candidates, supervisors, facilities, completion patterns, and integrity procedures. New doctoral admissions should require a resource statement and supervisory capacity check. Institutions should introduce advisory panels, standard progress reports, supervisor training, candidate handbooks, and accessible grievance mechanisms. A national graduate education dashboard should begin with a limited set of auditable indicators.

Phase 2: Capacity Building and Pilots, 3-5 Years

The second phase should fund competitive doctoral schools, thematic clusters, and shared facilities. TETFund should pilot integrated candidate and project awards in selected disciplines and institutions. Programme-level review should begin with a developmental cycle that identifies gaps without immediate punitive consequences. Joint supervision, regional consortia, and international partnerships should be expanded. Digital thesis repositories and research data support should become mandatory for accredited programmes.

Phase 3: Performance-Based Consolidation, 6-10 Years

The third phase should connect programme approval, admissions, and funding to verified performance. Periodic national evaluation should be fully operational, with published results and decisions on improvements. Funding formulas should reward completion quality, integrity, collaboration, and equitable candidate development rather than enrolment volume. Programmes unable to sustain minimum standards should merge, enter consortia, or suspend admissions. Successful clusters should receive longer-term support and stronger pathways to commercialisation, policy translation, or public engagement.

Implementation Risks and Safeguards

Reform can fail if new requirements become additional paperwork without resources. Milestones should therefore replace redundant approvals rather than accumulate on top of them. Digital reporting should reuse institutional data and be audited selectively. Smaller and newer universities should receive consortium options and capacity grants rather than being permanently excluded.

Performance funding can also create gaming. Publication counts may encourage low-quality outlets, completion targets may lower examination

standards, and internationalisation metrics may reward superficial partnerships. Balanced peer review, field-normalised indicators, integrity audits, candidate feedback, and transparent qualitative evidence are necessary safeguards. No single metric should determine programme status.

Equity must be built into implementation. Full-time, well-funded doctoral models may exclude candidates who work, care for dependents, or live far from campus. Programmes should offer transparent part-time routes with realistic milestones and equivalent standards. Funding competitions should monitor participation and success by gender, disability, region, socioeconomic background, and institution type. International mobility should not be the only route to quality because many candidates cannot travel.

Finally, reform requires political and institutional stability. Multi-year funding commitments, protected academic decision-making, open procurement, and public reporting are necessary to prevent policy discontinuity. A national framework should set the floor, but disciplinary communities and universities must retain sufficient autonomy to innovate above it.

Conclusion

Nigeria's graduate education challenge cannot be explained by the credit-hour system alone. Comparative evidence shows that credit-based structures coexist with highly research-intensive doctoral programmes. The United States uses credits while producing tens of thousands of research doctorates. India combines minimum coursework credits with advisory committees, recurring progress review, integrity safeguards, and external examination. South Africa uses credit-based qualification structures and publishes national doctoral data. The United Kingdom, Germany, Brazil, and African Centres of Excellence demonstrate the importance of funded training, doctoral structures, periodic programme review, and concentrated research investment.

The central Nigerian weakness is therefore not the existence of credits but the tendency to treat course completion as sufficient proof of graduate quality within an under-resourced and inconsistently governed research ecosystem. The original concerns about funding, supervision, infrastructure, global exposure, policy coherence, and academic migration remain valid, but they must be supported by evidence and connected through a defensible causal model.

Nigeria should retain credit for taught and professional development components while making research progression and graduation dependent on competencies, milestones, integrity, and independent assessment. A national graduate research quality framework, doctoral schools, trained supervisory teams, integrated funding, shared facilities, digital research systems, international and industry collaboration, and programme-level evaluation provide a practical reform architecture. The policy objective is not to move away from credits as an administrative tool. It is to move beyond credits as a proxy for rigorous research. Global alignment will depend on whether Nigeria builds and sustains the institutional conditions in which original, ethical, well-supported, and internationally credible research can be produced.

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CHAPTER THIRTY

Economic Assessment of Cinnamon-Enriched Diets in African Catfish Hybrid (Clarias gariepinus ♀ × Heterobranchus bidorsalis ♂) Cultivation

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Abstract

An assessment of the economic feasibility of including cinnamon in the diet of hybrid African catfish (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) was conducted throughout a 56-day feeding trial. Two hundred and ten fingerlings of hybrid African catfish were acclimatised for one week, weighed, and assigned to five feeding regimens containing 0, 0.5, 1.0, 1.5, and 2.0.% cinnamon. The diets were isonitrogenous at 38% and isolipidic at 12%. Each treatment was replicated three times, with 14 fish per replication. Fish were fed 5% of their body weight in two equal portions daily. An economic analysis was conducted utilising cost incidence, profit index, profitability ratio, and cost-return analysis as analytical instruments. The study's results demonstrated the viability of utilising cinnamon, as evidenced by favourable gross margins and net returns. CTR exhibited the highest levels of BCR and ROR, whilst DT5 showed the lowest. No significant differences ($p>0.05$) were seen in the BCR of fish fed the CTR and cinnamon-treated diets, except DT5. As the concentration of cinnamon increased, the BCR and ROR decreased. This study concluded that producing African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) with diets using cinnamon powder is economically viable. Reduced levels of cinnamon powder (0.5g/100g) in dietary formulations appear to yield economic returns similar to those of the control group.

Keywords: Cost incidence; Profit index; Profitability ratio; Cost-return analysis.

Introduction

Aquaculture can serve as an economical and high-quality protein source for human consumption and enhanced health (Ansari et al., 2021). The aquaculture sector has expanded globally because of advancements in production technology and cultivation techniques (Amenyogbe et al., 2018; Boyd et al., 2020; Naylor et al., 2021). The increased use of intensive fish production techniques by farmers to meet market demands and enhance profitability induces stress, alongside an elevated risk of disease and loss (Hoseinifar et al., 2020). The adverse environmental impacts of chemical use prompted the enactment of laws restricting their use as curative or preventive measures in aquaculture (Okocha et al., 2018). Consequently, dietary modifications, including the use of medicinal herbs in fish diets to promote growth and boost health, have been suggested as a feasible solution (Alagawany et al., 2021). Medicinal herbs have become increasingly favoured for the prevention and treatment of fish illnesses due to their environmental safety, cost-effectiveness, and minimal detrimental effects compared to chemical growth promoters and health enhancers (Doan et al., 2020). Plant-derived compounds rich in bioactive secondary metabolites have been shown to enhance fish immunity (Gabriel, 2019). Phytochemicals, which are active substances derived from plants, possess immunostimulant, biocidal, anti-stress, and growth-promoting effects. Tannins, alkaloids, pigments, essential oils, steroids, terpenoids, flavonoids, and phenolics are the predominant phytochemicals (Elumalai et al., 2020). Medicinal plants possess the capacity to treat and prevent fish illnesses owing to their rich content of secondary metabolites, which exhibit activity against various bacteria and fungi (Lieke et al., 2020). Recent applications of medicinal plant products (powders, essential oils, extracts, and isolated compounds) have been used to mitigate the adverse effects of stressors on fish, including toxicants and unfavourable environmental conditions (Tadese et al., 2021). Numerous studies have demonstrated that intact herbal materials and extracts enhance fish performance and welfare (Alagawany et al., 2021; Souza et al., 2019; Zhu, 2020).

Intact plant components, including turmeric (Curcuma longa), coffee bean (Coffea arabica), green tea (Camellia sinensis), Myrcia sylvatica, rhubarb (Rheum officinale), Roselle (Hibiscus sabdariffa), and ginger (Zingiber officinale), have been shown to enhance growth performance and mitigate stress in fish, as evidenced by various research studies (Abdel-Tawwab et al.,

2018; El Mesallamy et al., 2016; Fagbenro et al., 2004; Kuo et al., 2020; Pérez-Escalante et al., 2012; Sodamola et al., 2016).

Feed constitutes a substantial expense in the fish production cycle and is a critical determinant of the profitability and sustainability of aquaculture, representing 60 to 70 percent of the variable costs associated with fish production (Jimoh et al., 2020; Jimoh et al., 2019). Despite extensive research on the growth and health benefits of incorporating medicinal plants into fish feed, the economic ramifications of utilising medicinal plants, such as cinnamon powder, in fish feed, especially in terms of fish production economics, are yet to be investigated. This study, therefore, investigated the production economics of cinnamon supplementation in the diet of hybrid African catfish (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂).

Methods

Sources, Ingredient Processing, and Experimental Diets

Cinnamon powder, fish meal, soybean meal, and other beneficial feedstuffs were sourced from commercial suppliers in Ilorin, Nigeria, milled and screened separately to achieve a fine particle size, and duplicate samples were analysed for their proximate composition (AOAC, 2005). Cinnamon was included at concentrations of 0, 0.5, 1.0, 1.5, and 2.0g/100g in the experimental diets, designated as CTR, DT2, DT3, DT4, and DT5 (Table 1). The designed diets were isolipidic and isonitrogenous, including 12% crude lipid and 38% crude protein, respectively. To facilitate binding, the feedstuffs were pulverised and hot water was incorporated. The material was further processed through a pelleting and mixing apparatus, followed by a mincer to produce 2mm pellets, which were then immediately sundried at 30-32°C. The diets were preserved in a cold location during a three-day drying period. The nutritional composition (fatty and amino acids) of the experimental meals (Table 2) was assessed using a tool (Excel) developed by the Network of Aquaculture Centres in Asia-Pacific (NACA) in 2008.

Table 1: Gross Composition (G/100g) of Cinnamon-Supplemented Diet Fed to African Catfish Hybrid (*Clarias Gariepinus* ♀ X *Heterobranchus Bidorsalis* ♂)

Ingredients	CTR	DT2	DT3	DT4	DT5
Fishmeal@72%cp	27.80	27.80	27.80	27.80	27.80
SBM@44% cp	44.50	44.50	44.50	44.50	44.50
Yellow Maize@10%cp	4.00	4.00	4.00	4.00	4.00
Cinnamon	0.00	0.50	1.00	1.50	2.00
Fish Premix	5.00	5.00	5.00	5.00	5.00
Fish oil	2.50	2.50	2.50	2.50	2.50
Soy Oil	2.50	2.50	2.50	2.50	2.50
Starch	13.70	13.20	12.70	12.20	11.70
Total	100	100	100	100	100

Each kg of the Agri-mix fish premix contains Vitamin A 1500000 i.u, Vitamin B1 800mg; Vitamin B2 1,600mg, Vitamin B6 1,500mg, Vitamin B12 4mg, Vitamin D3 3,000,000 i.u, Vitamin E 200000mg, Vitamin C 240g, Folic Acid 300mg, Niacin 5970 mg, Biotin 40 mg, Pantothenic Acid 4000mg, Copper 800mg, Iodine 191mg, Iron 1200mg, Manganese 20,323mg, Selenium 60mg, Zinc 15996 mg, Choline 87000mg. Manufactured by Agri-Dom 20/22 Kolawole Shonibare Street, Ajao Estate, Lagos. www.agri-domintegrated.com.ng

Experimental Set-up and Feeding

The experiment was performed at the wet laboratory of the Department of Aquaculture and Fisheries at the University of Ilorin, Nigeria. The hybrid catfish fingerlings were procured from a reputed hatchery in Ilorin and transported to the project location in an aerated bag. Two hundred and ten hybrid catfish fingerlings were acclimatised to commercial catfish pelleted diet

for seven days prior to the feeding study. Each treatment consisted of five trials with three replicates, and each tank contained fourteen fingerlings. The tanks were randomly allocated to the experimental diet and were fed 5% of their body weight in two equal portions over 56 days, specifically during 9:00–10:00 am and 5:00–6:00 pm.

Analysis of Production Economics

The analysis of Production Economics was conducted using the indices (equations 1–11) as documented in Jimoh et al. (2019) and Jimoh et al. (2020).

$$Incidence\ of\ Cost = \frac{Cost\ of\ Feed}{Weight\ of\ Fish} \quad \text{..... (1)}$$

$$Profit\ Index = \frac{Value\ of\ Fish}{Cost\ of\ Feed} \quad \text{..... (2)}$$

$$Profit/kg\ \ = Value\ of\ 1kg\ fish - Incidence\ of\ cost \quad \text{.....(3)}$$

$$Total\ Cost\ (TC) = TVC + TFC \quad \text{.....…(4)}$$

Where TVC = Total Variable Cost (Cost of fingerlings + Cost of Feeding)

TFC = Total Fixed Cost (Cost of Aquaria Tanks)

Total Revenue(TR)=Price of Fish×Biomass Output (kg).....…..……(5)

Gross Margin (GM) =TR-TVC..... (6)

Net Return (NR) =GM-TFC ..... (7)

Expense Structure Ratio(ESR)=(Fixed Cost)/(Total Cost)..... (8)

Benefit-Cost Ratio (BCR)=(Total Revenue)/(Total Cost).....(9)

Gross Ratio (GR)=(Total Cost)/(Total Revenue).....(10)

Rate of Return (ROR)=(Net Return)/(Total Cost).....(11)

The straight-line method was used to assess the depreciation cost of aquaria tanks with the following properties;

Cost of Plastic Tanks (₦)	55,000
No of Years (Life span in years)	5
Savage Value (10%) (₦)	5,500

$$Depreciation = \frac{Cost\ Price - Salvage\ value}{Life\ Span}$$

$$Depreciation = \frac{55{,}500 - 5{,}500}{5} = ₦\ 9{,}900$$

$$Depreciative\ Cost\ of\ 2\ months\ plastic\ use = \frac{9{,}900}{12} \times 2 = ₦\ 1{,}650$$

$Depreciative\ Cost\ (TFC) = ₦\ 1{,}650$

Cost of Fingerlings =

(14*₦28) ₦ 392

Table 2. Nutrient Composition (G/100g As Fed Basis) of the Experimental Diets

Proximate Composition (%)	CTR	DT2	DT3	DT4	DT5
Moisture	8.14	8.12	8.10	8.08	8.06
Crude Protein	37.82	38.00	38.19	38.38	38.58
Crude Lipid	12.31	12.40	12.50	12.59	12.69
Ash	7.39	7.42	7.44	7.47	7.50
Crude Fibre	5.91	5.92	5.93	5.94	5.95
NFE	28.44	28.14	27.84	27.54	27.24
Amino Acid Composition (%)					
Arginine %	3.00	3.01	3.03	3.04	3.06
Histidine	0.94	0.94	0.94	0.95	0.95
Isoleucine	1.84	1.85	1.85	1.86	1.87
Leucine	3.00	3.01	3.03	3.04	3.06
Lysine	2.82	2.83	2.85	2.86	2.88
Methionine	0.86	0.87	0.87	0.88	0.88
M+C	1.38	1.39	1.39	1.40	1.41
Phenylalanine	1.76	1.77	1.78	1.79	1.80

P+T	3.05	3.07	3.08	3.10	3.11
Threonine	1.78	1.79	1.80	1.81	1.82
Tryptophan	0.47	0.47	0.47	0.47	0.48
Valine	2.00	2.01	2.02	2.03	2.04
Fatty Acid Composition (%)					
LOA (18:2n-6)	4.89	4.92	4.94	4.97	4.99
LNA (18:3n-3)	0.69	0.70	0.70	0.71	0.71
ARA (20:4n-6)	0.07	0.07	0.07	0.07	0.07
EPA (20:5n-3)	0.35	0.35	0.36	0.36	0.36
DHA (22:6n-3)	0.82	0.82	0.83	0.83	0.84
Total n-3	1.87	1.88	1.89	1.90	1.91
Total n-6	4.96	4.99	5.01	5.04	5.07
n3:n6	0.38	0.38	0.38	0.38	0.38
Total phospholipid%	2.69	2.70	2.72	2.73	2.74

LOA: Linoleic Acid; LNA: Linolenic Acid; ARA: Arachidonic Acid; EPA: Eicosapentanoic Acid; DHA Docosahexanoic Acid

Statistical Analysis

The data were presented as the mean and standard error of the mean (SEM). A one-way Analysis of Variance (ANOVA) was conducted in IBM SPSS Statistics for Windows, version 20.0, to evaluate the importance of each profitability evaluation parameter. Where substantial variance ($p<0.05$) was observed, Tukey's B was employed to distinguish significant differences among individual treatment means.

Results

Production cost of 1 kilogramme of diet

The expense (N) of generating 1kg of each diet with cinnamon powder for African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) is detailed in Table 3. The cost of producing 1 kg of the diet increased with the greater quantity of cinnamon powder used.

Table 3: Cost (₦) of production of 1kg of the experimental diets containing cinnamon

Ingredients	Cost/kg	CTR	DT2	DT3	DT4	DT5
Fishmeal@72%cp	1100.00	305.80	305.80	305.80	305.80	305.80
SBM@44% cp	270.00	120.15	120.15	120.15	120.15	120.15
Yellow Maize@10%cp	250.00	10.00	10.00	10.00	10.00	10.00
Cinnamon	6500.00	0.00	32.50	65.00	97.50	130.00
Fish Premix	600.00	30.00	30.00	30.00	30.00	30.00
Fish oil	1650.00	41.25	41.25	41.25	41.25	41.25
Soy Oil	675.00	16.88	16.88	16.88	16.88	16.88
Starch	500.00	68.50	66.00	63.50	61.00	58.50
Cost/kg Feed		592.58	622.58	652.58	682.58	712.58

Analysis of the costs associated with the production of African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) using diets supplemented with cinnamon powder

Table 4 presents the incidence of a cost analysis (IOC) for producing 1 kg of fish utilising experimental diets that include cinnamon powder, administered to African catfish hybrid fingerlings. The end weights of fish from cinnamon-based diets were numerically greater than those from the control group. However statistical similarity (P>0.05) was seen between them. Nonetheless, substantial changes (p<0.05) were observed in the cost analysis of producing 1kg of fish with the various experimental diets. The incidence of cost escalated with higher levels of cinnamon inclusion in the diet, with the DT5 group exhibiting the highest cost incidence, which was substantially higher (p<0.05) than that observed in other dietary treatment groups. No significant difference (p>0.05) was seen between the costs incurred for fish fed CTR and those fed DT2. The profit index for fish production and the profit per kilogramme of fish produced exhibited significant differences (p<0.05) among the various dietary treatment groups. The CTR-fed group achieved the highest results, while the DT5-fed group achieved the lowest results. No significant difference (p>0.05) was seen between the profit indices of fish produced by CTR and DT2.

Table 4: Incidence of a Cost Analysis of Producing African Catfish Hybrid (*Clarias Gariepinus* ♀ X *Heterobranchus Bidorsalis* ♂) with Diets Containing Cinnamon Powder

	Control	DT2	DT3	DT4	DT5
Final Weight of fish ($x10^{-3}$kg)	10.60±0.43[a]	10.33±1.03[a]	11.94±1.43[a]	12.72±1.69[a]	11.25±0.1
Value of Fish Produced (₦)	10.60±0.43[a]	10.33±1.04[a]	11.94±1.43[a]	12.72±1.70[a]	11.25±0.1
Feed Fed ($x10^{-3}$kg)	10.87±0.74[a]	10.66±1.66[a]	12.85±2.23[a]	13.01±1.66[a]	12.80±0.1
Cost/kg feed	592.58	622.580	652.58	682.58	712.58

Cost of Feed Fed (₦)	6.44±0.44^{c}	6.64±1.03^{bc}	8.39±1.45^{abc}	8.88±1.14^{ab}	9.13±0.78
Incidence of Cost (₦)	607.07±29.63^{d}	634.833±40.69^{cd}	692.71±49.30^{bc}	699.39±26.86^{b}	776.60±108^{a}
Profit Index	1.65±0.77^{a}	1.59±0.10^{ab}	1.46±0.10^{bc}	1.43±0.53^{c}	1.29±0.27
Profit/kg fish produced (₦/kg fish)	392.93±29.63^{a}	365.16±40.70^{ab}	307.29±49.30^{bc}	300.60±26.86^{c}	223.39±108^{d}

Row means with different superscripts are significantly different ($p<0.05$) from each other

1 USD= N413.88

Market Price of 1kg fish = N1000

Analysis of costs and returns associated with the production of African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) with experimental diets incorporating cinnamon powder

The cost and return analysis for the production of African catfish hybrid (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) fingerlings utilising experimental diets with cinnamon powder is detailed in Table 5. No significant change ($p>0.05$) was seen in the biomass produced. The biomass generated with DT4 was the highest, whereas DT5 yielded the lowest. The total cost of producing fish with CTR was the lowest. However, there was no statistical difference ($p > 0.05$) in total costs across the dietary treatments. The gross margin and net profit diverged from total cost: fish produced by CTR achieved the highest profit margin and net return. The gross margin and net return diminished in the cinnamon-treated dietary groups compared to the control group, although exhibited statistical equivalence ($p>0.05$) to the control group.

Table 5: Cost And Return Analysis of Producing African Catfish Hybrid (*Clarias Gariepinus* ♀ X *Heterobranchus Bidorsalis* ♂) with Experimental Diets Containing Cinnamon Powder

	Control	**DT2**	**DT3**	**DT4**	**DT5**
Biomass produced (kg)	10.60±0.43[a]	10.33±1.03[a]	11.94±1.43[a]	12.72±1.69[a]	11.25±0.16[a]
Total Revenue (₦) x10^3	10.60.01±0.44[a]	10.33±1.04[a]	11.94±1.43[a]	12.72±1.70[a]	11.25±0.16[a]
Cost of Feeding (₦) x10^3	6.44±0.44[a]	6.64±1.03[a]	8.39±1.45[a]	8.88±1.14[a]	9.13±0.78[a]
Total Variable Cost (₦) x10^3	6.83±0.44[a]	7.03±1.03[a]	8.78±1.45[a]	9.271±1.14[a]	9.52±0.78[a]
Total Fixed Cost (₦) x10^3	1650±0.00	1650±0.00	1650±0.00	1650±0.00	1650±0.00
Total Cost (₦) x10^3	8.48±0.44[a]	8.68±1.03[a]	10.43±1.45[a]	10.92±1.14[a]	11.17±0.08[a]
Gross Margin (₦) x10^3	3.77±0.33[a]	3.30±0.70[a]	3.16±0.37[a]	3.45±0.70[a]	2.24±0.23[a]
Net Return (₦) x10^3	2.12±0.33[a]	1.65±0.07[a]	1.51±0.37[a]	1.19±0.70[a]	0.59±0.23[a]

Row means with different superscripts are significantly different ($p<0.05$) from each other.

Profitability assessment of cultivating African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) utilising experimental diets supplemented with cinnamon powder

The economic study of producing hybrid African catfish (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) using diets supplemented with cinnamon powder is detailed in Table 6. A substantial difference ($p<0.05$) was seen in the

Benefit-Cost Ratio (BCR) and Rate of Return (ROR) associated with the various dietary regimens for fish production. CTR exhibited the highest BCR and ROR values, whilst DT5 displayed the lowest. No substantial variations ($p>0.05$) were seen in the BCR of fish fed the control and cinnamon-treated diets, with the exception of DT5. The gross ratio (GR) exhibited a divergent trend compared to the benefit-cost ratio (BCR) and Rate of Return (ROR). No significant differences ($p>0.05$) were seen in the expense structure ratio of fish generated under different dietary regimens.

Table 6: Profitability Analysis of Producing African Catfish Hybrid (*Clarias Gariepinus* ♀ X *Heterobranchus Bidorsalis* ♂) with Experimental Diets Containing Cinnamon Powder

	Control	DT2	DT3	DT4	DT5
Benefit Cost Ratio	1.25±0.43^{a}	1.19±0.20^{a}	1.15±0.42^{a}	1.15±0.50^{a}	1.05±0.02^{b}
Gross Ratio	0.80±0.03^{b}	0.83±0.02^{a}	0.86±0.32^{a}	0.87±0.04^{a}	0.95±0.02^{a}
Expense Structure Ratio	0.19±0.01^{a}	0.19±0.02^{a}	0.16±0.02^{a}	0.15±0.01^{a}	0.14±0.001^{a}
Rate of Return	0.25±0.04^{a}	0.19±0.02^{a}	0.15±0.07^{a}	0.16±0.05^{a}	0.05±0.02^{b}

Row means with different superscripts are significantly different ($p<0.05$) from each other

Discussion

The research employed biomass production, economic viability, and profitability as metrics to assess the economic feasibility of integrating cinnamon into the practical diets of African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂). The principal nutritional categories of fish demonstrated a significant response to feeding. The increased biomass seen in the cinnamon-based dietary groups compared to the control group may be attributed to the bioactive constituents in the feed, which could stimulate the gustatory and olfactory nerves of fish consuming cinnamon-enriched diets, as suggested by Pallaya-Baleta et al. (2021). Our results mirrored those reported by Habiba et al. (2021), who fed European sea bass (Dicentrarchus labrax) a cinnamon-based diet. Abdel-Tawwab et al. (2018) documented a beneficial

growth-enhancing effect of dietary cinnamon nanoparticles on Nile tilapia (Oreochromis niloticus), consistent with the findings of this investigation. The inclusion of cinnamon in the diet elevated the cost per kilogramme of the experimental diets, resulting in diminished profit margins for the groups that received cinnamon. This contrasts with our previous findings about the economic analysis of substituting basic feed ingredients for protein sources (Jimoh et al., 2015; Jimoh et al., 2020; Jimoh et al., 2019). Cinnamon serves a fundamental role as an additive in diets; its dose-dependent increase will significantly affect the cost per kilogramme of feed produced and the cost of producing one kilogramme of fish, as the variable production costs rise with higher levels of cinnamon inclusion in the diet. Nevertheless, all dietary treatments resulted in a profit index over 1, indicating the profitability of feeding African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) with cinnamon-based diets. Nonetheless, the profit index and profit per kilogramme of fish produced diminish with the increasing incorporation of cinnamon. The mean total variable cost and the overall cost of producing African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) with diets featuring different inclusion levels of cinnamon were offset by the total revenue generated from the sale of these hybrids, leading to a favourable gross margin and net returns across all dietary treatment groups. A positive gross margin and net returns indicate profitability in feeding (Jimoh et al., 2015). The diminished gross margin and net return in the experimental dietary treatments relative to the control were attributable to the supplementary expense of cinnamon incorporation in the diet of African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂), rather than inferior growth performance. This suggests that, despite substantial evidence supporting cinnamon's growth-promoting properties, the economic implications of its dietary inclusion may not justify its use. As the concentration of cinnamon increased, the BCR and ROR diminished A larger Benefit-Cost Ratio (BCR) indicates greater profitability; the further it deviates from 1, the more profitable it becomes. All dietary interventions produced fish with a BCR exceeding 1. The incorporation of 20g/kg of cinnamon resulted in reduced growth. The diminished palatability of the feed at a greater cinnamon inclusion level (20%) may account for the observed reduction in growth. This aligns with the findings of Habiba et al. (2021).

Conclusion

This study's findings indicated that including cinnamon into the diets of African catfish hybrids (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂) is economically feasible. In addition to its growth-promoting properties, the cinnamon powder was an economical supplement. The incorporation of cinnamon presented several disadvantages, including its high cost. Consequently, incorporating a higher level is not economically feasible. Future experiments may explore additional techniques to lower the cost of cinnamon for incorporation into the diets of the African catfish hybrid (Clarias gariepinus ♀ x Heterobranchus bidorsalis ♂). Reduced concentrations of cinnamon powder (0.5g/100g) in dietary formulations appear to yield economic yields similar to those of the control group.

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CHAPTER THIRTY-ONE

Empowering Sustainable e-Commerce through Digital Education: Bridging Knowledge Gaps for Green Consumerism

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Abstract

Digital education is crucial in promoting sustainable e-commerce since it enables consumers and businesses with the knowledge required in green consumerism. This research filled knowledge gaps regarding ethical consumption and environmentally-friendly business operations via the utilisation of digital education. Secondary data was used to evaluate the effectiveness of digital literacy projects and sustainability-oriented learning platforms. The results indicated that although digital infrastructure is growing, there is lack of sustainability-related material within the digital education in mainstream. The inclusion of such materials, especially by using the AI-based and locally based modes of learning, can greatly promote the awareness of green consumer behaviour and sustainability of supply chains. The research illustrated that policy formulation, curriculum exchange, and local area centered interventions are necessary tools that can enable communities to obtain the digital assessments necessary to support responsible e-commerce.

Keywords: Digital Education, Eco-Friendly Business Practices, Green Consumerism, Sustainable e-Commerce.

Introduction

Over the past twenty years, the world of e-commerce has been changing more rapidly as a result of sky-soaring digitalisation rates, shifts in consumer behaviour, and mobile technology. With the growth of digital marketplaces, the negative impact on the environment also increases, which raises the question of whether online commerce is sustainable. Neither over packaging and energy-demanding logistics nor environmental impact of fast fashion and technology consumption can be neglected, and the consequences of e-commerce on nature are numerous and complicated (Mangiaracina et al., 2015; Lim et al., 2021). To

this end, there has been an increasing uprising of the demand to have sustainable e-commerce as a paradigm which aims at ensuring that the digital retailing business is brought in line with the environmental, social and economic sustainability pursuits. Yet, throughout the process of switching to sustainable models, it is not only the underlying change of systems in supply chains and businesses but also an informed and ecologically conscious consumer that is required. Here digital learning comes in to play.

Green consumerism can be defined as the inclination of consumers to make purchasing choices based on the environmental factors that include biodegradability, eco-labeling, and responsible sourcing. This measure has risen in popularity through the previous 10 years, especially amongst younger, digitally natural populations that require convenience in addition to the conscience in their consuming behaviours (Johnstone & Tan, 2015). Online stores now feel the pressure to provide environmentally friendly substitutes of products and evidence on their green statistics. The availability of such options however does not always translate into uptake. Evidence indicates that the inability to be aware of what is supposed to be branded as a green product, the presence of a disunity in labeling to consumers, a general lack of environmental literacy along with other economic inducements are some of the leading reasons as revealed by research why consumers fail to gain a clear understanding of what it entails to make a product be seen to be green (Testa et al., 2020).

Such disconnect necessitates the educational strategy relying on the use of digital tools to increase consumer knowledge. Online education, campaigning on social media, gamifying sustainability, and eco-influencer platforms can be an essential part of the process of shaping behaviours and instilling sustainable principles (Hessel barth &Schaltegger, 2014). These platforms can also support scalable, inclusive, and context-specific educational interventions, particularly in developing economies where the traditional channels of education could be unavailable.

Governmental, academic, NGO and corporate e-commerce collaboration is however key in development and sharing of effective learning content. Such multi-stakeholder model renders credibility, relevance and scalability of green

education initiatives. The bottom line is that providing consumers with knowledge about sustainability not only encourages them to make greener decisions but also makes the companies innovate, compete, and offer environmentally-friendly products and services. The intersection of the two realities stimulated by climate urgency and the digital revolution, sustainable e-commerce, and green digital learning is the much-needed channel of change. With consumers and business interacting more and more with the online platforms, there is a critical need to integrate sustainability knowledge into digital environments.

Nonetheless, although there is an increasingly diverse international literature pointing out the positive relationship between digital literacy and sustainable behaviours, there are still some research gaps that exist in India (especially in semi-urban and rural districts, such as Ara in Bihar). The majority of the available literature, including those in China and Taiwan (e.g., Zhai et al., 2024; Chen et al., 2024; Lin & Huang, 2023), have strong empirical support on the implications of the digital skills to green behaviour through various ways such as ecological cognition, and self-efficacy, and innovation capability. Nevertheless, a similar study has been conducted in India, mostly among urban dwellers or generational cohorts who mainly cover Gen Y and Z in rural cities (Ghouse et al., 2024), So, there is a major gap in viewing how digital literacy promotes sustainable behaviour in rural or low-income areas. There is another large gap in curriculum and pedagogical content of digital education projects. Although some initiatives have been successful in enhancing digital inclusion, they tend to overlook the concept of sustainability (at least locally) to the extent of training digital inclusion modules at a district or grass-root level. In addition, integration of AI powered teaching technologies with the awareness of sustainable business practices in India is poor. Even though in other regions we have evidence that AI tools, such as predictive models, gameplay modules, and personalised learning systems, may be employed to increase the sustainability of supply chains and engagement in the student bodies (Teixeira et al., 2025; Mokhtar et al., 2023), the usage of these technologies and capabilities is still low within the sustainability education and e-commerce industries. That implies that there is a high-level research and implementation

gap between the concept of using AI to enhance the personalisation of green consumer education and expand awareness levels within regional economies.

Lastly, in spite of the continuous efforts on the digitisation mission, the policy framework of digital literacy is still not localised, especially in learning sustainability. A majority of digital skilling efforts fail to internalise eco-literacy or ethical consumerism among the central elements, thus compromising a chance to develop the capacity to engage in a sustainable lifestyle at the local levels. Educational policy and digital training should be reconsidered so that it would suit the sustainability objectives, particularly in sectors that are underrepresented. This study addressed these white spots by analysing the way digital education (enriched with the content supporting sustainability and intelligence-based customisation) could help to empower consumers and small business owners to embrace green e-commerce. As it aimed at providing insightful work towards scholarly explanations it provided a significant contribution based intervention towards effective policy applications that could facilitate sustainable digital change in underserved areas in India.

Thus, this study examined the role of digital education (especially in the setting of such regions as Ara district of Bihar, India) to overcome major knowledge gaps limiting the implementation of green consumerism and an environmentally friendly business strategy. Based on the secondary sources of data (industry insights and academic studies), the study drew attention to the prospects of the sustainability-driven digital literacy, AI-facilitated learning tools, and policy intervention in facilitating ethical consumption and the involvement of green supply chains.

Research Objectives

1. To examine the role of digital education and how it can be used to increase understanding and awareness of green consumerism by consumers and small businesses in Ara, Bihar.

2. To determine how the introduction of sustainability-oriented courses and digital literacy courses may close the knowledge gap and conduct eco-friendly commerce practices through e-commerce.

3. To investigate how AI based learning platforms and individualised digital methods of education can be used to promote responsible consumption and sustainable supply chain knowledge.

Literature Review

Digital Literacy and Pro-Environmental Behavior

The paper by Hu and Meng (2022) reported two studies that addressed similar issues relating to the role of digital literacy in enhancing green consumption through psychological mechanisms based on social cognitive and self-regulatory roles. The presence of green products was found to increase some of these psychological responses, which support pro environmental decisions. Zhai et al. (2024) examined how having the digital literacy would influence the behaviour of farmers to green production technology in China. Ecological cognition was noted in mediation analysis as a key mechanism that brings digital ability into long-lasting practice (Zhai et al., 2024). In addition, a research in Hainan Province, China (Chen et al., 2024), showed that elevating digital literacy is quite substantial in enlarging eco- friendly policy cognition in the rural population and participation in engagement in eco- friendly activities.

Digital Education and Sustainability in University Contexts

Lin and Huang (2023) investigated the connection between the digital ability and sustainable behaviour of university students in Taiwan. Based on the findings of two case-study samples (students of tourism/hospitality and leisure/recreation), it was established that employability skills, innovation capability, information sharing and involvement are the mediators that could attenuate the relationship between the digital capability and the sustainability behaviour. Such mediators were different concerning different subjects of academic study but they all demonstrated the importance of digital education in promoting sustainable attitudes and practices. The study of Trakoonsanti and Abbas (2025) explored the contributing factors of educators, policymakers, and

teachers of Thailand regarding the influences of TAM and TPB models to determine that environmental awareness, green consumption motivation, perceived usefulness of the digitalised tools, and sustainability knowledge all had a positive effect on green consumer behaviours. A combination of these constructs translated digital interaction to eco conscious behaviour (Trakoonsanti& Abbas, 2025).

AI, Supply Chain Management, and Sustainability Education

A systematic review was carried out by Teixeira, Ferreira, and Ramos (2025) regarding adding Artificial Intelligence to supply chain management. They also examined the major roles of AI in predictive analytics, optimisation and traceability, and stated that explainable AI and digital twins are significant ones in the development of supplying chains sustainability. But barriers to adoption are legacies systems, and data issues and ethics (Teixeira et al., 2025). As shown in the study conducted by Jahin et al. (2023), the current situation with AI/ML models in predicting supply chain risks suggests that the new methods such as XGBoost and hybrid models can considerably enhance the predictive accuracy and robustness of logistics risk prevention.

Educational Technology for Sustainability Learning

Sustainable supply chain management education was also addressed in a study by Mokhtar, Sundram, and Shahrom (2023) which focused on ways in which the process of teaching could be gamified and imbued with augmented reality, as well as which modules to teach people with the assistance of AI. They also registered much more engagement and retention of learners in immersive, interactive educational technology than in static engagements (Mokhtar et al., 2023).

Thematic Synthesis and Identified Gaps

Theme	**Key Insights**	**Gaps Identified**
Digital Literacy → Green Behavior	Consistently positive effects mediated by ecological cognition and self-efficacy	Few studies in semi-urban/rural India

Interface Nudges in E-commerce	Environmental information nudges boost sustainable decisions	Lack of Indian/Bihar focus on UI interventions
AI in Supply Chains	Emerging tools boost efficiency and traceability, but require ethical/governance frameworks	Limited integration of digital literacy & skill-building
Digital Education Models	Smart EdTech (IoT/AR/gamification) dramatically improves sustainability knowledge	Need for scalable models in developing regions (e.g., Bihar)
Digital Inclusion Platforms in India	National portals enhance access to learning but lack sustainability-specific courses	Need curricular inclusion for green consumerism in district-level programs

Research Methodology

This study used secondary data-based research approach to find out the role of digital education in the fostering of sustainable e-commerce and green consumerism. The source of data contained government reports, policy paper, academic journal articles, white papers published in the industry, and analytics of digital education platforms in the context of digital literacy and sustainable practices. The insights in these sources were synthesised in a qualitative content analysis format in which patterns, gaps, and correlation between the digital education initiatives and eco-friendly consumer behaviours are identified. This approach facilitated the explication of the context within which available digital framework and educational interventions are manifested in moderating sustainable online shopping and business activities of rural and semi-urban Indian environment.

Data Analysis

This comes out as a detailed analysis to determine the impact of digital education in sustainable e-commerce and development of green consumerism.

Green consumer awareness and Digital Education

Digital literacy in the context of India is also more and more considered as a baseline requirement to participate in the civic life of a country, economic life and environmental awareness. Digital literacy has been limited by such challenges as inadequate access to devices, connection, and the appropriate learning materials in semi-urban and rural places. When environmental literacy is integrated in digital learning, its impact can considerably change consumer awareness about green consumerism (Hu & Meng, 2022). Nevertheless, this is an untapped potential in the Indian rural areas. The district-level economies have a low level of consumer awareness of concepts, including ethical consumption, environment labelling, and reduction of carbon footprints (Confederation of Indian Industry [CII], 2022). The lack of organised digital curricula that can cover these themes creates a continuous knowledge gap on the side of consumer and small-scale internet retailers. There is an increasing role of social media in forming the popular perspectives on sustainability. Informal learning becomes Twitter, YouTube, WhatsApps, and local content-based applications. Yet, how reliable and factual sustainability information is on these platforms is highly diverse. Although such outreach mediums are effective in reaching out to consumers on a greater scale, they are not well poised to change consumer behavior because there are no standardized, evidence-based digital learning materials in place (Vaidya & Kumar, 2025).

Integration of Sustainability-Focused Content in Digital Literacy Programs

Digital education platforms on a national level provide a comprehensive access to open-access education resources. Environmental awareness is normally covered within an overall science course or environmental science course, and it is going to include the topics like e-commerce, green consumerism, etc. Digital education focuses on the infrastructure development as the provision of smart classrooms and digital devices at the expense of a dedicated curriculum on sustainable digital practices. As a result, learners are inadequately prepared to make informed decisions associated with sustainable consumption, ethical sourcing, or circulating e-commerce services. The disconnection between digital literacy and sustainability education is further increased by the absence

of the specific intervention at the local level. The other reports also highlighted the role of providing digital skills to small and medium enterprises (SMEs), which come with the sustainability perspective.

AI-Driven Learning Platforms and Personalized Education for Sustainability

Artificial intelligence (AI) is transforming the education field with personalised learning platform, customised content delivery, and intelligent feedback mechanism. Although some other digital platforms have adopted AI to improve learning performance, little use has been applied to integrate sustainability related content into these systems (Teixeira, Ferreira, & Ramos, 2025). The use of AI-based personalisation is focused mostly on test preparation or skill development in such areas as mathematics and science, whereas the promotion of behavioural learning in terms of sustainability is rather narrow. The world-wide research has also demonstrated that AI can be effective in raising sustainability awareness once the schools use such environmental data in educational algorithms (Hasan, 2024). AI also has a potential in training the local businesses on sustainable supply chaining practices.

Implications for Policy and Practice

The analysis implies a multipronged plan in order to empower sustainable e-commerce with the help of digital learning. The priority of policymakers in ensuring sustainability literacy needs to be embedded in developing the current digital training programs and be customised by regions and inclusive. EdTech platforms should be pushed to integrate environmental themes in their main products, and AI should be used to implement adaptive and personal recommendations of the content. In the conversion of high level environmental ideas to local practice, NGOs and community educators can be important players in this initiative as they help both consumers and small enterprise owners.

Finally, a combination of digital education or a digitally powered learning experience, sustainability awareness, and technological advancement hold the potential solution to encouraging responsible consumption in India. But to create this possibility, we must go out of our way to redesign educational

content, delivery systems and institutional structures that will shape the future of e-commerce and online learning.

Findings

The study analysed how digital education may advance sustainable e-commerce and narrow knowledge gaps in terms of green consumerism. The key findings presented in the background of the three research objectives create crucial understanding of the interdependence between digital literacy, sustainability education, and responsible consumer behavior.

Digital Education and its role in Green Consumerism

The results showed that online learning can certainly be of great value in building and maintaining environmental awareness and consumer environment-friendly behaviour. Nonetheless, this potential has not been used fully utilised in the semi-urban and rural areas. Although initiatives at the national level have helped in enhancing the basic digital literacy, the initiatives are not mostly sustainability-oriented. The subjects like the environmental decision-making, sustainable product choice, an ecological effect of online consumption are not addressed to learners very often. In addition, the prevalence of unstructured digital contents on social media frenzies such as YouTube and WhatsApp indicates that casual avenues are molding the mindset of the people. However, there are no quality controls; hence no evidence-based content to the material to make it educationally viable in promoting change of behaviour. It is evident that the basic digital access does not yet coincide with the level of informed, sustainability-oriented digital engagement that the environmental issue needs to engage in building the green consumerism.

The blending of Digital Education on Sustainable Modules is Insufficient

The most significant gap, which was found in this study, consists in the presence of little sustainability-related content that would be integrated into the mainstream online educational platforms. A majority of the modules offered in terms of sustainability are only theoretical, generic or found in many college programmes in environmental-related sciences, and do not hold application to online buying or green business establishment. Such absence of contextualised and actionable content does not enable learners to attain competencies and take

useful challenge in an enduring digital economy. The study indicated that neighborhood participation and local models can help to make sustainability education less abstract and less theoretical, and more practical.

AI for Environmental Literacy: The Need for Better Integration

Artificial Intelligence (AI) and adaptive learning platforms have transformed the field of delivery of education across a number of areas and their use to sustainability education in India could be more beneficial to all members of society. These platforms have a lot of potential to bring more of a green consumer, or digital ethic, or environmental values into their adaptive learning framework. Though AI is gradually finding its way on the functional fronts in India, especially in the field of agricultural traceability and supply chains optimisation, the innovations have been mostly business based. An opportunity to develop potentially revolutionary potential of holistic sustainability learning could be opening educational facets of these tools. The feather between commercial uses of AI and educational settings would meld the systems towards a more coherent system- a more substantive and pragmatic knowledge of sustainability in the various learning communities.

No Combination of Digital Literacy and Sustainability Goals is Presented in Policy Frameworks

Fragmentation between the digital literacy policies and sustainability education is another important finding. Every nation and state tends to approach these separately as separate entities, and thus opportunities to achieve synergy are also missed. Whereas there has been an increased appreciation by most parts of the globe, sustainability as a fundamental digital competency, the educational policy is yet to respond to this inclusion in rural areas. It is encouraging that the state policy documents have concentrated greatly on digital accessibility and ground training as a major stride to digital empowerment. Nevertheless, it is still a great opportunity to complement these activities with adding the awareness of the environment and the ethics of a good consumer to the set of core learning outcomes. At present, the lack of direct policy and curriculum requirements of digital skills training in undertaking sustainability education translates to a variant of digital literacy whose proficiency in technology is

informative, but yet remains ignorant of environmental awareness. Combining the two issues of digital empowerment and environmental stewardship by filling this policy gap gives a significant chance to make the evolution of a more comprehensive and wider-lensed model.

Localised, Culturally Relevant Content Is Essential for Impactful Learning

The study underlined that specify-related and culturally relevant content enhances participation and understanding between learners to a large extent. The problem with generic digital content is that it does not appeal to learners in semi-urban and rural regions. On the other hand, if the sustainability education is provided in local languages with scenarios, which are close to the learner, it can help him or her internalises the skill and applies it. It is significant to decentralise content development, engage the local educators, NGOs, and learners in co-designing sustainability curriculum. Top-down, one-size-fits-all methods have less potential to effect behaviour change than community-based models that rely on deceptively simple, technology-friendly languages and local case studies of success. This means that green consumerism awareness needs to be embedded on the socio-cultural context of the learners in particular regions.

Conclusion

The study examined the interplay between digital education and sustainable e-commerce, which has been found to be an interesting and quite complicated sphere of study and practice with a narrower focus on the district of Ara in Bihar, India. The main assumption that digital education may become an effective instrument in knowledge transfer in the question of green consumerism was explored with the help of an in-depth analysis of secondary data, which provided the idea of current drawbacks, future opportunities, and the course to go. The study concluded that though there has been enhancement of digital infrastructure and access due to national programmes, policy and support, integration of sustainability related content and courses into digital learning ecosystems are seriously lacking. Even digital literacy may still be mainly functional in its focus in rural and semi-urban areas, failing to reach the level of conceptual knowledge or situational applicability to create

environmental responsibleness in behaviours. This indicates a huge gap between technology access and its capability of making sustainable decision-making. As it has been noted so far, although some of the biggest educational platforms cover the issue of environmental literacy, much can be done to make such material richer and more practice-based. These platforms can provide an effective way to deal with the issues affecting the real world such as daily online shopping, ethical shopping, and conscious consumption, etc. The role of Artificial Intelligence in facilitating sustainability education can be exploited to a great extent. The AI-powered software has already shown impressive progress in providing individualised academic experiences, and there is a good potential in taking into consideration the concept of sustainability. The new generation shopping interface based on environment rating, and adaptive green learning tools, present a useful guideline on future developments in this field. The lack of tools, especially in rural areas, provides an insight into a potential opportunity to create and deploy new AI-based tools devoted to teaching sustainability. This study, in the framework of policy analysis, noted the necessity of closing the existing gap between digital literacy and sustainability concerns that are usually discussed independently both in educational policies and governance. The combination of these areas can play a leading role in revealing the effectiveness of empowering people through digital methods. A broader-based and more interdisciplinary policy that would treat sustainability as a pillar of digital citizenship can be developed to support a more comprehensive and future-forward growth in the learning outcomes of the whole of India. In the real sense, the road map to the sustainable e-commerce in India should always be inclined towards technology but also reformative education. Online learning should also become an instrument of awareness, agency, and action as opposed to access. Such shift is especially acute in such districts as Ara as the digital infrastructure is being developed, and the educational material is not up to date with the social-environmental problems of the 21st century any longer. Through identification of these gaps and opportunities, this study added to the academic discussion and provided practical guidelines that can be pursued by policymakers, educators, and technologists. Sustainable digital education of the consumers and the business cannot be just a developmental requirement but also an indispensable measure

to ensure inclusive, resilient and clean green development of the digital economy of India.

Limitations

Although this study provided many significant details about the position of digital learning in supporting the emergence of sustainable e-commerce and the promotion of green consumerism, it had its own drawbacks. The study relied exclusively on the availability of secondary information including policy reports, literature publications, and industry reports; and hence would not account the life experiences and behavioural peculiarities of local consumers and businesses as well as real time perceptions. The lack of primary data gathering limited the possibility of proving the results with the help of directly asking questions from the stakeholders to specify recent changes in the digital habits. Further, limited generalisability of the results can be also attributed to the specific socio-economic and cultural peculiarities of the region that are unlikely to apply to the rest of the districts. The dynamically changing character of the digital technologies and sustainability models also implies that some of the mentioned platforms or initiatives can radically get changed, which may influence the applicability of the study in the long-run.

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CHAPTER THIRTY-TWO

Navigating Cultural Diversity in Globalised Education Systems: An Empirical Analysis of Leadership Practices among Student Unions

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Abstract

As education becomes increasingly globalised, higher institutions have become a hub for cultural exchange where individuals from different cultures, languages, and ethnic groups interact. In addition to academics, the institutions are places where students from many backgrounds can share their perspectives and experiences. Against this backdrop, educational leaders face the complex challenges of navigating diversity and fostering inclusivity where academic excellence thrives. This study employed a descriptive survey research design, focusing on undergraduate students at Al-Hikmah University. A sample of 200 students was selected from the population of 6,852 undergraduate students at the institution through simple random sampling to gather insights into their perceptions of the influence of culturally responsive leadership on student union leaders' practices. Data were collected using a structured questionnaire titled "Culturally Responsive Leadership and Students' Participation Scale" (CRLSPS). The analysis involved descriptive statistics to summarise the data and inferential statistics, including regression analysis, to test the formulated hypotheses at a 0.05 significance level. Findings revealed that student leaders demonstrated a high level of culturally responsive leadership, with an overall mean score indicating effective cultural awareness and inclusive practices, as well as high participation in various campus activities. Based on the findings, the study recommends that universities implement training programs focused on culturally responsive leadership to equip student leaders with the skills needed to foster inclusivity. Additionally, institutions should create supportive environments that encourage active participation from all students, ensuring that campus activities reflect the diverse cultural identities of the student body.

Keywords: Inclusiveness, Globalisation, Culture, Leadership practices.

Introduction

Education is a crucial foundation for both personal and societal development. It is not just about academic success; it involves the overall development of individuals, preparing them to actively participate in their communities and make positive contributions (Santamaria & Santamaria, 2016). In this regard, education serves as a bridge between individual aspirations and societal progress, shaping future leaders and contributors to economic, social, political and cultural development. According to the National Policy on Education, one of the primary objectives of higher education in Nigeria is to promote national unity. This implies that education should bring together students from different cultural, social, economic and religious backgrounds. Nigeria is a deeply multicultural society, home to over 250 ethnic groups and a range of religious traditions. This diversity is both a strength and a source of tension, as historical conflicts and socio-political divisions have shaped the country's educational landscape. However, this diversity often brings about challenges, including intergroup tensions, cultural misunderstandings and systemic inequalities (Brown et al., 2022). Institutions of higher education are microcosms of the broader society, reflecting its complexities and challenges. The presence of students from varied backgrounds creates a unique opportunity for dialogue and collaboration, but also necessitates intentional efforts to address cultural sensitivities and foster unity. Higher education institutions serve as a melting pot for diversity, creating opportunities for understanding and collaboration among young Nigerians (Johnson & Fuller, 2015).

Effective leadership within these institutions is critical for harnessing the potential of diversity. Student leaders play a vital role in shaping campus culture, advocating for inclusivity, and addressing the unique needs of their peers. According to Khalifa et al (2016), leadership in a multicultural environment requires not only awareness of cultural differences but also a commitment to equity and respect for all individuals. In Nigerian tertiary institutions, where students often encounter cultural differences for the first time, student leaders have the responsibility to model inclusive behaviour and create spaces where everyone feels valued through activities that actively engage students with the experiences of diverse groups and implement practices that promote fairness and inclusivity. Frawley et al (2020) argue that culturally responsive leaders are proactive in addressing disparities, ensuring that all voices are heard and that every student has the opportunity to succeed.

This is particularly important in Nigeria, where socio-economic inequalities and cultural biases can marginalise certain groups. For instance, a culturally diverse classroom may lead to richer discussions and more comprehensive problem-solving approaches. However, these benefits can only be realised if institutions actively address the challenges associated with diversity.

Culturally responsive leadership is a critical aspect of educational leadership that emphasises understanding and valuing diverse cultural backgrounds in educational settings. According to Ladson-Billings (2020), culturally responsive leadership involves recognising the cultural strengths and assets of students from diverse backgrounds and using this knowledge to inform decision-making and practices within educational institutions. This approach is rooted in the belief that culture plays a significant role in shaping students' identities, experiences, and academic success. Culturally responsive leadership involves recognising, respecting, and valuing the diverse cultural backgrounds and experiences of individuals within an educational community. In a multicultural society, university students need to develop culturally responsive leadership skills to effectively engage with diverse populations and promote social justice. This project will focus on understanding how university students in Kwara State perceive and practice culturally responsive leadership in their academic and social interactions.

In the context of universities in Kwara State, Nigeria, culturally responsive leadership plays a crucial role in promoting inclusivity, equity, and academic success among students from diverse cultural backgrounds. Kwara State is known for its rich cultural diversity, with various ethnic groups and traditions coexisting within the region. Therefore, it is essential for university leaders to adopt culturally responsive practices to effectively support and empower students from different cultural backgrounds. Effective leadership is crucial for fostering inclusive and diverse campus environments, promoting student engagement, and enhancing academic success. However, leadership styles and practices can be culturally bound, and cultural responsiveness is essential for effective leadership in diverse university settings (Ladson-Billings, 2020). While much of the literature on CRL comes from Western contexts, its application in non-Western settings such as Nigeria remains underexplored. In the Nigerian context, particularly in Kwara State, there is a pressing need to examine how culturally responsive leadership can be implemented to bridge the gap between students' diverse cultural backgrounds and university

leadership practices. This study seeks to address this gap by exploring the implications of CRL in Kwara State's higher education institutions.

Literature Review

Cultural Competence Theory, updated by Sue et al. (2019), emphasises the necessity for leaders to develop skills to interact effectively with students from diverse cultural backgrounds. Cultural competence involves not only understanding one's own cultural identity but also recognising and addressing cultural differences. Leaders who are culturally competent are better equipped to support diverse students, enhancing both their academic experiences and success (Sue et al., 2019). In practice, culturally responsive leadership involves continuous professional development in cultural competence, the implementation of inclusive policies, and fostering open dialogues about cultural issues. By adopting these theories, leaders in Kwara State universities can effectively navigate the complexities of cultural diversity, creating an environment where every student feels valued and empowered, thereby supporting their academic and personal growth. Theoretical and practical evidence underscores the importance of CRL in addressing challenges posed by cultural diversity in educational leadership. For example, research by Banks (2019) stresses the necessity of preparing students for a multicultural and interconnected world, advocating for leadership practices that prioritise inclusivity and equity. Although each author emphasises different dimensions such as multicultural preparation, systemic equity, or academic success, all studies recognise cultural competence as an essential prerequisite for effective leadership, differing mainly in whether they emphasise its development, application, or contribution to social justice.

This field explores leadership practices that recognise, respect, and integrate students' varied cultural identities, fostering a supportive and inclusive academic environment. The theoretical framework for culturally responsive leadership is based on key concepts emphasising cultural awareness and inclusivity. Effective leadership is believed to be enhanced when leaders engage with the cultural identities of their students, understanding and adapting practices to meet diverse needs. Several contemporary theoretical perspectives shape this framework for culturally responsive leadership in Kwara State. These frameworks guide leaders in engaging with a diverse student body and promoting academic and personal growth. Banks (2019) also noted that leadership practices in higher education must be designed to prepare students

for a multicultural and interconnected world. He suggested that universities should promote inclusivity by ensuring that leadership reflects diverse student experiences and needs. Research by DeAngelis and DeAngelis (2018) corroborates the importance of CRL in promoting positive student outcomes, particularly in terms of academic achievement, retention, and social integration. Geneva Gay (2018) highlights the transformative potential of culturally responsive practices, emphasising their role in creating equitable educational systems. She asserts that CRL involves fostering cultural competence among students and staff while addressing systemic barriers that hinder academic success. Similarly, Ladson-Billings (2020) argues that leaders must incorporate cultural knowledge into their decision-making processes to ensure all students feel represented and supported.

Academic collaboration thrives within a diverse environment. Students from varied backgrounds work together on research projects, leading to innovative solutions and a deeper understanding of complex issues (Ojo, 2019). Furthermore, the linguistic diversity on campus, with languages such as Yoruba and Hausa spoken alongside English, promotes a multilingual environment and enhances communication skills (Ogunyemi, 2021). Universities in Kwara State frequently organise cultural exchange programs and seminars to foster cross-cultural understanding. These events provide opportunities for students to share and learn about each other's traditions (Salami, 2022). Student organisations and clubs dedicated to specific ethnic and religious groups further support this cultural exchange, creating strong networks that enhance both academic and social experiences (Eze, 2020). Cultural diversity also manifests in campus dining and events. Food festivals and cultural nights allow students to experience a variety of cuisines, showcasing Nigeria's culinary richness (Durojaiye, 2021).

Additionally, traditional performances and art exhibitions provide platforms for celebrating and appreciating the diverse cultural heritage of the student body (Akinola, 2021). The presence of international students adds another dimension to campus life, encouraging global understanding and cooperation (Ibrahim, 2023). Moreover, diverse student groups often collaborate on community service projects, integrating cultural insights to address social issues effectively (Musa, 2022). To accommodate and honour this diversity, universities provide facilities such as multi-faith prayer rooms and culturally-themed study areas (Olaniyan, 2022). These amenities ensure that the needs of all students are

respected and met. While Ojo (2019) and Ogunyemi (2021) focus on the academic advantages of diversity, Salami (2022), Eze (2020), and Durojaiye (2021) emphasise cultural exchange through institutional activities and student organisations. Ibrahim (2023) and Musa (2022) further highlight diversity's contribution to global understanding and community development. Together, these studies suggest that cultural diversity becomes an institutional strength when leaders intentionally create opportunities for interaction, participation, and inclusion. Their studies collectively conclude that cultural diversity enriches university life by enhancing learning, innovation, collaboration, and intercultural understanding when supported by inclusive leadership.

According to Ladson-Billings (2020), advocates for the incorporation of cultural knowledge into leadership decision-making processes to ensure all students are represented and supported. Scholars such as Banks (2019) also stress the necessity of preparing students for a globalised, multicultural world by promoting leadership practices that prioritise inclusivity, equity, and social justice. Culturally responsive leadership, derived from the concept of culturally responsive pedagogy, involves those leadership philosophies, practices, and policies that create inclusive schooling environments for students and families from ethnically and culturally diverse backgrounds. Common practices include emphasising high expectations for students' achievement, incorporating the history, values, and cultural knowledge of students' home communities in the school curriculum, working to develop a critical consciousness among both students and faculty to challenge inequities in the larger society, and creating organisational structures at the school and district level that empower students and parents from diverse racial and ethnic communities. Similar terms to describe this approach to leadership include culturally proficient leadership, culturally relevant leadership, culture-based leadership, cultural competency, multicultural leadership, and leadership for diversity. Although there are subtle differences in how authors and researchers employ these different terms, in general, these approaches encourage teacher leaders, school principals and district level leaders to "lead for diversity" and work with teachers, parents, and the larger community to develop curriculum frameworks, pedagogical practices, and organisational structures and routines that are consistent with the cultural orientations of ethnically diverse students and their families. While much of the investigation of culturally responsive practices has focused on classroom teaching, recent efforts have applied a culturally responsive framework to school leadership. Despite using different

concepts and terminology, the reviewed studies converge on the importance of inclusive leadership practices that integrate diversity into institutional structures and decision-making.

In general, these studies characterise culturally responsive school leaders as those who emphasise high expectations for students' academic achievement, exhibit an ethic of care, promote inclusive instructional practices, and develop organisational structures that empower parents and the broader community in the life of the school. Culturally responsive leadership often overlaps with "leadership for social justice" approaches, a term that has been prevalent in the Kwara state educational literature and focuses on improving the educational experiences and outcomes for all students, particularly those who have been traditionally marginalised in schools. While this bibliography incorporates some sources that focus on socially just leadership, it emphasises those school leadership theories and practices that respond to issues of ethnicity, culture, language, and race. Ann E. Lopez (2016) emphasises that culturally responsive leadership is essential for fostering inclusivity and promoting positive change in diverse educational environments. She argues that without cultural competence, students may face difficulties in leading diverse groups, addressing issues related to social justice, and promoting equitable participation among peers. Similarly, Banks (2013) and Nieto (2017) highlight the importance of cultural competence in leadership development, noting that inclusive leadership practices help prepare students to become agents of change, capable of addressing issues such as inequality, discrimination, and social exclusion.

Despite the growing recognition of the importance of cultural responsiveness in leadership, limited research has been conducted on how university students, particularly in Nigerian contexts like Kwara State, perceive and practice culturally responsive leadership. This lack of empirical studies has left a gap in understanding both the specific challenges students face in diverse environments and how these challenges might be overcome through targeted leadership development programs. Furthermore, while universities in Nigeria are increasingly embracing diversity, the absence of a structured framework to address cultural differences within leadership development programs means that many students may lack the skills needed to lead inclusively. As a result, students may miss valuable opportunities for personal and professional growth, and the university community may experience fragmentation and lack of

cohesion, undermining both academic and extracurricular activities. Kwara State is known for its rich cultural diversity, with various ethnic groups and traditions coexisting within the region. Therefore, it is essential for university leaders to adopt culturally responsive practices to effectively support and empower students from different cultural backgrounds. In conclusion, this project will contribute to the existing literature on culturally responsive leadership in higher education and provide practical recommendations for promoting cultural competence and inclusivity among university students in Kwara State. By fostering culturally responsive leadership skills, students can become effective advocates for diversity, equity, and social justice within their academic and professional endeavours. In the diverse academic environment of Kwara State, university students are frequently called upon to assume leadership roles within their academic institutions, often representing a wide array of cultural, ethnic, and socioeconomic backgrounds.

However, a critical concern exists regarding the preparedness of these students to engage in leadership practices that respect and incorporate cultural diversity. Despite the growing importance of leadership in university life, there is a significant gap in the education and training related to culturally responsive leadership. Without this crucial cultural competence, students may encounter challenges in leading effectively, resulting in exclusionary practices, interpersonal conflicts, and diminished team dynamics that negatively affect academic and social outcomes. While leadership development programs in Nigerian universities have focused on skills such as decision-making, communication, and problem-solving, there is insufficient attention given to the integration of cultural diversity into leadership practices among students. This is especially true in Kwara State, where university students come from a variety of ethnic, religious, and cultural backgrounds. The failure to incorporate culturally responsive leadership training in university curricula means that many students may struggle to navigate and lead in a multicultural environment, leading to challenges such as misunderstandings, marginalisation, and a lack of cohesion among diverse student groups.

The literature demonstrates a broad consensus that culturally responsive leadership fosters inclusion, equity, and improved educational outcomes through leaders' cultural competence and inclusive practices. While previous research has extensively examined these issues among school leaders and institutional administrators, there is limited empirical evidence concerning

student union leaders in Nigerian universities. This gap provides a strong justification for investigating how culturally responsive leadership influences leadership practices among student unions in globalised higher education systems. This study seeks to fill this gap by investigating the experiences and challenges of university students in Kwara State regarding culturally responsive leadership. It aims to explore the barriers that prevent students from leading inclusively, identify the key competencies needed for culturally responsive leadership, and propose practical strategies for integrating cultural responsiveness into leadership development programs. By addressing these issues, the study hopes to enhance students' leadership abilities, foster greater inclusivity, and contribute to the development of a more harmonious and productive university community.

Problem Statement

Culturally responsive leadership is becoming increasingly important in higher education as universities face the challenges of growing diversity on their campuses. Despite the importance of CRL, significant challenges remain in implementing such leadership in Kwara State universities. One of the main barriers is the lack of formal cultural competence training for university administrators and faculty. While many leaders recognise the importance of cultural inclusivity, they often lack the skills or knowledge necessary to effectively implement strategies. Another challenge is resistance to change, particularly in institutions where traditional leadership styles are deeply entrenched, making it difficult to adopt new practices that prioritise cultural responsiveness. Additionally, resource constraints present a challenge, as universities may struggle to allocate the funds and personnel needed to support inclusive initiatives. Nevertheless, culturally responsive leadership is essential for ensuring that universities in Kwara State offer an inclusive and supportive environment for all students, regardless of cultural background. Empirical studies show that while there is growing recognition of the importance of cultural diversity, more concrete actions are required to translate this awareness into effective leadership practices. By providing training in cultural competence, developing inclusive policies, and engaging more directly with students from diverse backgrounds, university leaders can create academic environments that are not only culturally inclusive but also conducive to the success of all students.

Unfortunately, many student leaders struggle to develop the skills and frameworks needed to create inclusive environments that genuinely value cultural differences. This gap often leaves marginalised groups feeling isolated, which can significantly affect their sense of belonging and academic success. Research shows that culturally responsive leadership bridges these divides by fostering equity, trust and collaboration. Yet despite its potential, practical implementation among university students remains limited (Mansfield & Lambrinou, 2022). Lack of culturally responsive practices among student leaders can lead to issues such as underrepresentation and biases in decision-making, leading to alienation among minority students. Even though the importance of culturally responsive leadership is widely acknowledged, many universities fall short in providing adequate training for student leaders to develop the necessary cultural competencies. This lack of preparation means that valuable opportunities to harness cultural diversity as a strength in leadership practices are often missed.

Although culturally responsive leadership has gained increasing attention in educational leadership literature, significant gaps remain. Existing studies have largely focused on school administrators and faculty, leaving limited knowledge about how culturally responsive leadership influences leadership practices among university student union leaders. Furthermore, most previous studies have employed qualitative or descriptive approaches, with few using predictive quantitative methods such as multiple regression to examine these relationships. In addition, there is a paucity of evidence from Nigerian universities, particularly in Kwara State, where increasing cultural diversity presents unique leadership challenges. Addressing these gaps is essential for generating evidence that can strengthen culturally responsive leadership practices and promote inclusive student leadership in globalised higher education systems.

Purpose of the Study

The primary purpose of this study is to explore culturally responsive leadership among university students in Kwara State. Specifically, the study will aim to:#

i. I. How often do University students participate in campus activities?

ii. What impact does culturally responsive leadership have on leadership practices?

iii. What is the impact of cultural awareness of student leaders on leadership practices?

Methodology

This study adopted a descriptive survey research design to examine the relationship between culturally responsive leadership and leadership practices among student union leaders in a culturally diverse higher education environment. The descriptive survey design was considered appropriate because it enables the collection of quantitative data from a representative sample of respondents at a single point in time and facilitates the examination of relationships among variables without manipulating the study environment. The study population comprised 6,852 undergraduate students of Al-Hikmah University, Ilorin, Kwara State, Nigeria. A sample of 200 undergraduate students was selected using convenience sampling. The sampling technique was considered appropriate because the study targeted readily accessible students who were willing to participate in the online survey. Furthermore, convenience sampling facilitated timely data collection within the available resources while providing adequate responses for regression analysis.

Data were collected using a structured questionnaire comprising two sections. Section A elicited respondents' demographic information, including gender, age, level of study, faculty, and previous participation in student union activities. Section B measured the study variables using items adapted from Hines's (2022) culturally responsive leadership framework. The questionnaire assessed four dimensions of culturally responsive leadership: inclusiveness, development, validation, and cultivation as the independent variables, while leadership practices constituted the dependent variable. Responses were measured on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). To ensure content and face validity, the questionnaire was reviewed by experts in Educational Management and Measurement and Evaluation, who assessed the relevance, clarity, and adequacy of the items in relation to the study objectives. Their observations informed the revision of ambiguous statements before the instrument was administered.

A pilot study was conducted among students at a university outside the study area who had characteristics similar to those of the study participants. The

internal consistency of the instrument was determined using Cronbach's Alpha. The overall reliability coefficient was 0.83, indicating satisfactory reliability. Participation was voluntary, informed consent was obtained from all respondents, anonymity was maintained, and participants were assured that the information provided would be used solely for research purposes. The questionnaire was converted into a Google Form, and the survey link was distributed through official student communication platforms. Responses were exported from Google Form to Microsoft Excel and into Statistical Package for Social Sciences (SPSS) for analysis.

The demographic characteristics of the respondents were analysed using frequency counts and percentages, while descriptive statistics (mean and standard deviation) were used to summarise responses to the study variables. Prior to the analysis, the data were screened for completeness, missing values, outliers, and data entry errors. The assumptions underlying multiple regression analysis were also examined. Normality was assessed using skewness and kurtosis values as well as a normal probability plot; the results confirmed that the data satisfied the assumptions for multiple regression analysis. Thereafter, descriptive statistics were used to answer the research questions, while multiple regression analysis was employed to determine the predictive influence of the dimensions of culturally responsive leadership on leadership practices among student union leaders. Statistical significance was determined at the 0.05 level.

Findings

Research Question 1: What is the level of students' participation in campus activities?

Table 1: Students' Participation in Campus Activities

S/N	Items	Mean	SD	Decision
1.	I take part in events and programmes organised by my school	3.34	0.64	High
2.	I join clubs, groups or student organisations on campus	3.20	0.75	High
3.	I attend seminars, workshops or talks arranged by the school	3.21	0.77	High
4.	I participate in cultural and social activities at school	3.09	0.80	High
5.	I get involved in sports and fitness activities offered by the school	3.09	0.80	High

6.	I take part in student leadership and decision-making	3.15	0.79	High
7.	I volunteer for school events or service projects	3.13	0.75	High
8.	I help plan and organise activities for other students	3.12	0.79	High
9.	I feel encouraged by the school to join campus activities	3.16	0.79	High
10.	I believe my participation in campus activities helps me learn	3.18	0.76	High

Key: <2.50 = Low, >2.50 = High

Table 1 shows that the level of students' participation in campus activities in Al-Hikmah University was high. Specifically, students agreed that they take part in events and programmes organised by the school, with a mean score of 3.34, they also indicated active involvement in clubs, groups, or students' organisations on campus. Other items also suggest that students are actively engaged in a wide range of campus activities and feel supported by their institutions in contributing to a vibrant campus community.

Research Question Two: What impact does culturally responsive leadership have on students' participation in school activities?

Table 2: ANOVA on Culturally Responsive Leadership and Students' Leadership Practices

Model		Sum of Squares	Df	Mean Square	F	Sig
1	Regression	5.606	1	5.606	35.459	.000
	Residual	31.304	198	.158		
	Total	36.910	199			

This table presents the analysis of Variance (ANOVA) results used to elevate the statistical significance of the regression model examining the impact of culturally responsive leadership on students' participation in school activities. The regression sum was 5.606, indicating the proportion of variation in students' participation that is attributable to culturally responsive leadership. The model produced f-statistic of 35.459, with a significance value of .000, which is well below the conventional .05. This result indicates that the model is statistically significant, meaning that culturally responsive leadership of

student leaders as a predictor significantly improves students' participation in campus activities. The residual sum of 31.304 represents the portion of variance in students' participation not accounted for by the model. Since the p-value is less than .05, the results provide strong evidence to confirm that culturally responsive leadership has a significant impact on students' active participation in campus activities.

Research Question 3: What are the impact of cultural awareness of student leaders on leadership practices

Table 3: ANOVA on cultural awareness and leadership practices

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.899	1	2.899	16.879	.000[b]
	Residual	34.010	198	.172		
	Total	36.910	199			

a. Dependent Variable: Leadership Practices

This table presents the analysis of Variance (ANOVA) results used to elevate the statistical significance of the regression model examining the impact of cultural awareness of student union leaders on leadership practices in the university. The Analysis of Variance (ANOVA) results were used to assess the statistical significance of the regression model, examining the impact of cultural awareness of student leaders on students' participation in campus activities in Al-Hikmah University, Ilorin, Kwara State. The regression sum of squares was 2.899, indicating the proportion of variation in students' participation that is attributable to cultural awareness. With 1 degree of freedom, the corresponding mean square was also 2.899. The model produced an F-statistic of 16.879, with a significance value ($p = .000$), which is well below the conventional threshold of 0.05. This result confirms that the regression model is statistically significant, meaning that the inclusion of cultural awareness as a predictor significantly improves the model's ability to explain variation in students' participation. The residual sum of squares was 34.010, representing the portion of variance not explained by the model. Given that the p-value is less than .05, the results provide sufficient evidence to reject the null hypothesis. Therefore, it can be concluded that cultural awareness of

student leaders has a significant impact on students' participation in campus activities.

Discussion of Findings

Findings from research question one revealed that students reported a high level of participation in campus activities, with a mean score of 3.18. This suggests that students are actively involved in academic, social, and co-curricular initiatives, indicating a vibrant and inclusive campus culture. The implication of this finding is significant: when students perceive that their identities are respected and their voices heard, they are more likely to contribute to campus life. Rugambuka and Mazzuki (2023) affirmed this by stating that inclusive and respectful environments are catalysts for student engagement and participation. Similarly, Ettekal et al. (2020) argued that culturally relevant programming activities that reflect students' cultural values, traditions, and experiences increase students' sense of ownership and belonging within academic institutions. Adding to this discourse, the findings of Deni Surapto et al. (2024) in a study on inclusive leadership in distance higher education programs revealed that leadership styles that prioritise inclusion and representation significantly enhance both student participation and retention. Their study highlights the relevance of inclusive leadership beyond traditional campus settings, showing its impact in diverse learning modalities. This supports the notion that participation is not solely an outcome of student interest but is deeply influenced by the institutional climate and leadership practices that either promote or inhibit engagement.

Research question two tested hypothesis that specify the statistically significant impact of culturally responsive leadership on leadership practices. The result demonstrates a moderate positive impact of culturally responsive leadership on leadership practices ($\beta = .390$, $p < .001$). This result indicates that students are more likely to engage actively in campus life when student leaders employ leadership styles that respect cultural identities and promote fairness and collaboration. It highlights the critical role of leadership in shaping student behaviour and motivation. This finding is in line with Solis-Grant et al. (2023), who reported that students show higher levels of engagement and institutional loyalty in environments where leadership is inclusive and culturally attuned. Barksdale (2024) similarly emphasised that students feel empowered to participate when they perceive that their leaders are fair, empathetic, and culturally competent. Reinforcing this view, Murwanto (2024) showed that

inclusive leadership across various educational contexts plays a transformative role in ensuring participation and dismantling structural inequities that limit access to involvement for marginalised student groups. Together, these findings imply that culturally responsive leadership should not be viewed as a supplemental trait but as a foundational element of effective student governance and campus development.

Finding from research question three revealed that cultural awareness among student union leaders significantly predicts leadership practices within the university environment. The regression model was statistically significant ($F = 16.879$, $p < .05$), indicating that cultural awareness contributes meaningfully to explaining variations in leadership practices. This suggests that student leaders who demonstrate greater awareness and appreciation of their peers' diverse cultural backgrounds are more likely to adopt inclusive, participatory, and effective leadership practices. The finding underscores the importance of cultural awareness as a critical leadership competency for promoting cohesion and fostering meaningful engagement within multicultural university communities. This finding is consistent with the principles of culturally responsive leadership, which emphasise that effective leaders acknowledge, respect, and integrate the cultural identities of those they serve into leadership decision-making and organisational practices (Geneva Gay, 2018; Gloria Ladson-Billings, 2020).

According to James A. Banks (2019), leaders who possess strong cultural awareness are better positioned to create inclusive environments that promote equity, mutual respect, and active participation among culturally diverse groups. Similarly, Derald Wing Sue et al. (2019) argue that cultural competence enhances leaders' ability to understand diverse perspectives, minimise cultural bias, and foster positive interpersonal relationships, thereby improving leadership effectiveness. The finding further supports Hines' (2022) culturally responsive leadership framework, which identifies cultural awareness as a foundational element of effective leadership in diverse educational settings. Student leaders who understand and appreciate cultural differences are better equipped to resolve conflicts, communicate across cultural boundaries, and make decisions that reflect the interests of diverse student constituencies. Such leadership practices contribute to stronger organisational cohesion and greater participation in university activities. This finding implies that universities should intentionally integrate cultural

awareness into student leadership development programmes. Leadership training should extend beyond administrative and organisational skills to include cultural competence, diversity management, inclusive communication, and intercultural collaboration. Such initiatives would enhance the capacity of student union leaders to effectively navigate cultural diversity and promote inclusive participation within increasingly globalised higher education systems.

Conclusion

This study examined the influence of culturally responsive leadership on leadership practices among student union leaders in Al-Hikmah University, Ilorin, Kwara State, within the context of an increasingly globalised and culturally diverse higher education environment. The findings revealed that students actively participate in campus activities and that culturally responsive leadership significantly enhances effective leadership practices. Specifically, cultural awareness emerged as a significant predictor of leadership practices, demonstrating that student leaders who recognise, appreciate, and respond to the diverse cultural identities of their peers are more likely to foster inclusive, participatory, and collaborative leadership. These findings affirm that culturally responsive leadership is not merely a desirable leadership attribute but an essential competency for promoting equity, mutual respect, and meaningful student engagement in multicultural university settings. The study contributes to the growing body of literature on culturally responsive leadership by extending its application beyond institutional administrators to student union leadership, an area that has received limited empirical attention, particularly within the Nigerian higher education context. By employing a quantitative approach to examine the predictive relationship between culturally responsive leadership and leadership practices, the study also provides empirical evidence that addresses existing methodological and contextual gaps in the literature.

The study concludes that universities seeking to strengthen student leadership should intentionally integrate culturally responsive leadership into student leadership development programmes. Training initiatives should equip student leaders with competencies in cultural awareness, inclusive communication, intercultural collaboration, conflict management, and equitable decision-making. Such efforts will not only enhance the effectiveness of student unions but also promote social cohesion, strengthen students' sense of belonging, and prepare future leaders capable of navigating the complexities of increasingly

diverse and globalised educational environments. This suggests that beyond simply understanding students' cultural identities, student leaders who actively promote equity, shared decision-making, and fair treatment are more likely to foster a vibrant and participatory campus culture. It can therefore be concluded that culturally responsive leadership is not just a value-driven approach but also a practical strategy for enhancing student engagement and fostering community among a diverse student body. Promoting inclusiveness and culturally aware student leadership can improve the social and academic life of students on campus.

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