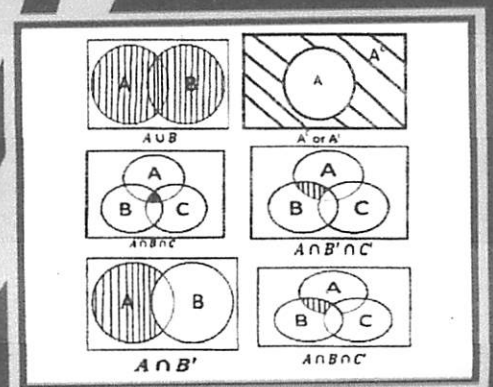


ENHANCING MATHEMATICS EDUCATION IN NIGERIA

A FESTSCHRIFT IN HONOUR OF
PROFESSOR MICHAEL
OLUBUSUYI FAJEMIDAGBA



Edited by:
Prof. Medinat F. Salman

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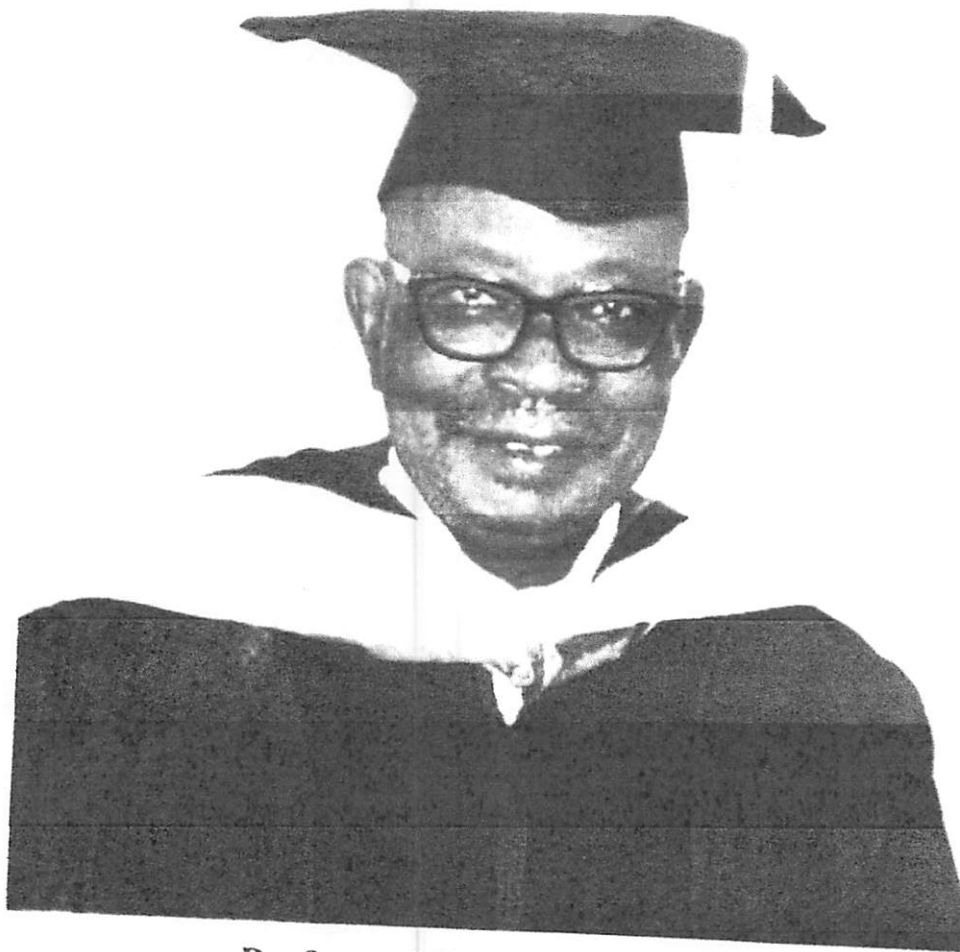
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**Professor Michael Olubusuyi
FAJEMIDAGBA**

PROFILE

Profile of Professor Michael Olubusuyi Fajemidagba, Professor of Mathematics Education, Department of Science Education, University of Ilorin, Ilorin, Nigeria

Early Life and Educational Training

Professor Olubusuyi Fajemidagba, was born on the 2nd of February, 1948 at Ijeda-Jesha, Oriade, Local Government Area of Osun State. He had his primary school education at United Methodist School Ijeda-Iloko, Osun State between 1954 and 1960. He attended United Secondary Modern School, Ijeda-Iloko (1961 – 1963), Then, went to Wesley College, Ibadan for NCE, 3 years teacher training programme between 1965 and 1967. Prof. Fajemidagba attended University of Ife (now Obafemi Awolowo University) in Ile-Ife, Osun State and graduated with a B.Sc. Education (Mathematics/Physics) degree, Second Class Honours (Upper Division). He obtained his Master and Doctor of Education degrees in Mathematics Education from the State University at Albany, New York State, United States of America, between 1978 and 1982. He enjoyed a number of scholarships and prizes during the period of his studentship.

Work Experience

Prof. Fajemidagba started his teaching career as a class teacher at Methodist Central School, Ado-Odo, Ogun State, between 1968 and 1971. He was also a class teacher in a secondary school in Gombe during the one year National Youth Service Corps between 1975 and 1976. He had a brief stint as an Education officer at Oyo State Ministry of Education, Ibadan from July to September, 1976. He was appointed Assistant Lecturer in the Department of Curriculum Studies and Educational Technology, University of Ilorin in September, 1976. By dint of hard work, Prof. Fajemidagba rose through the ranks and was appointed a Professor of Mathematics Education on the 1st of October, 1995. Since then, he had served in different academic and administrative capacities at various levels within and outside the University of Ilorin.

Achievements

The young Fajemidagba, by all parameters can be regarded as the founding father of Mathematics Education Programme at the University of Ilorin, Ilorin, Nigeria. Prof. Fajemidagba was Head of Department twice at different periods. He was Chairman, University of Ilorin Admissions and Certificate Screening Committee. He has produced several graduates and supervised to completion several Master and PhD Degree holders in Mathematics Education. He served as External Assessor for promotion of lecturers to Professors in many Universities in Nigeria. He was a member of Accreditation Team of NCCE and NUC for several Colleges of Education and Universities, respectively. He developed undergraduates' curriculum for Mathematics Education and he was a facilitator for the training of in-service teachers at different levels of education in Nigeria.

He is a member of the Editorial Board for Abacus: The Journal of the Mathematical Association of Nigeria. Prof. Fajemidagba served the Mathematical Association of Nigeria (MAN) in various capacities. He was a member, Organizing Committee for MAN Conference in 1986 and 1994. Kwara State Chapter; Returning Officer for MAN Executive Officers Election in Port Harcourt 1991; Member: MAN Committee on Curriculum Organization in Nigeria (CON), and National Council of Teachers of Mathematics. In recognition of his meritorious services, MAN awarded him a Fellow of the Mathematical Association of Nigeria (FMAN) in 2014.

At different times, he served on various Committees in the Department, Faculty, and University. These include: University Joint Council and Senate Committee, Director of General Studies Unit, and Director Centre for Technical and Entrepreneur of the University. He was also a writer and reviewer to National Teachers' Institute and Nigeria Educational Research and Development Council.

Prof. Fajemidagba is happily married with children and grand children.

**AN INTERVIEW WITH PROFESSOR MICHAEL OLUBUSUYI
FAJEMIDAGBA**

Q: As the Pioneer Lecturer of Mathematics Education at the University of Ilorin, briefly tell us about your life history Sir?

A: I was born at Ijeda – Jesha, in 1948 and I attended primary and part of my secondary school education there before I went to Ibadan Wesley College for a 3 year teacher training programme. I graduated in 1967 from the College and I was posted to a village near Badagry as a class teacher. I was later transferred to Ado-odo where I spent about three and half years before gaining admission into the University of Ife now Obafemi Awolowo University for a four year degree programme, and graduated in 1975 and then proceeded to NYSC in the North Eastern State which is now Borno State.. This current President, Mohammadu Buhari was the Governor of the State at the time. During the NYSC, I came across an advertisement from the University of Ilorin then University College and I applied. We were interviewed at Ibadan and later I got a letter that I should report at Ilorin for employment as an Assistant Lecturer. We started Education Department with a Teacher Education programme. I was in Mathematics Education, there were people in Biology Education, Chemistry Education, and so on.. After two years, I left the University on sponsorship to United States of America to pursue post graduate programmes in 1978. I completed Doctorate degree in 1982 and returned to University of Ilorin in February 1983. By the time I resumed, the Department had changed, new lecturers had been employed and I started with Lecturer II even though I came in as an Assistant Lecturer. At that time, there were many undergraduate students under Mathematics Education programme, while some came in for Master and Ph.D. among them was Professor Salman M.F. and others. The first Ph.D. student I graduated was Adelodun, my classmate at Wesley College, Ibadan . He was at College of Education, Ikere Ekiti. Others which later followed are Professor (Mrs.) Salman, Late Dr. Ilori, Dr. Sulaiman, while Drs. Akanmu and Ayinla are recent ones. When we had more Masters and Ph.D. students that I alone could not cope with, the Department needed more hands in Mathematics Education. We applied to the University to get more hands and that was how we brought in Prof. Salman and both of us have been handling the programme. Recently, we brought in Akanmu as Assistant Lecturer, followed by Dr. K. S. Ameen as Lecturer II and Mrs S. M. Adeniji as Assistant Lecturer, we then have a full house, but now that I am checking out, the leadership will rest on Prof. Salman. The Department has to look for someone not as a professor to fill the vacancy to have a full house back.

Q: When you resumed duty Sir, you must have some visions and missions for Mathematics Education, what are these visions and missions?

A: Yes, we came in with first degree and it was Teacher Education Programme. Prof. Abiri was the Dean handling the affairs of the Department but when I returned in 1983, and I looked at the programme then I asked the then HOD; Prof. Abdullahi to study the

programme because he studied in the USA and understands what to do since we were running the course system. I said there was need to increase the number of Mathematics courses because the aspect of mathematics programme was empty. This is because nobody could stop anybody from moving to any level. that was why I suggested that students must offer Mathematics courses at the 400 level. It was a lot of cry and hues because people believed we should only teach secondary school Mathematics. Most of them could not appreciate the reasons for asking the students to offer Mathematics at 400 level. I said that their view was not correct that they were not only trained to teach, but that, undergraduate programme, was meant to liberate students' minds and afford them the opportunity to move to other work places or disciplines. Those of them who offered Mathematics up to 400 level, some of them are now in Mathematics Department and have become Professors today. Prof. I. O. Abimbola, too, started that for Biology.

Q: Aside from bringing up Mathematics Education students that can easily diversify into Mathematics Majoy / Mathematics Education, What other mission or vision did you have as at that time?

A: Our vision and mission were for well trained Mathathemics teachers because of the 6-3-3-4 system that was similar to US Educational Policy and even in Japan because not everybody would be able to go beyond first degree. But, if you have first degree and the programme is very sound and the teachers are well trained, things will change at the secondary school level. We were trying to recruit good students in those days, I was looking at those who had good results such as A1, A2 in Mathematics and those who came from Colleges of Education, they must have A or B in Mathematics so that they could be able to cope with undergraduate Mathematics.

Q: Starting from your assumption of duty till this present time, how can you rate yourself?

A: Haa, I have tried my best, I cannot score myself A or B but when I look back I am so proud that at least one of my students is a Professor, that is Prof. (Mrs.) Salman, that is a big achievement. Some of my students are also Professors in the Mathematics Department, any time I get to Mathematics Department many of them will run out to say why don't you send for us. So am happy about that, I have no regret at all.

Q: We are aware of the different positions that you have held in this University. At your two tenures as HOD, what were your contributions?

A: The first time I was acting HOD, you people are lucky that the unhealthy rivalry of wanting to be HOD was no more there, I never struggled for anything. That first year, was for learning how to manage the system. You have some Academics and non-academics who were easy to deal with, some of the people cooperate while some did not. Some are easy to work with while some are not. Some just wanted money and not the work and that was why I had problem with them. I later left for the GNS, as Director. That was where I had the opportunity to serve diligently.

Q: As one-time Director of GNS and Director, Technical and Entrepreneurship Centre what were your experiences and challenges within the university community?

A: I was not new to GNS because I had been assisting the unit before I was appointed as Director. Any time they wanted to conduct exams; I was always assisting them as invigilator/ supervisor. When I was appointed Director, I easily coped with the work. The first challenge I faced was leakages of questions and I was happy that I was able to stop it. There were some Lecturers that you had to run after get results from them because they would not mark on time and they would be complaining that they were not paid on time. But, luckily when I got there, I was able to pay them on time because the money was in the Unit and we could easily go to the bank, cash the needed funds and pay the concerned Lecturers. Those who persisted in writing books for the University each year were paid some royalties from the sales of the books. I was the only full-time Academic staff and all other academic staff were part-time lecturers. Those who were full-time workers there are non-academic staff, so you have to understand how to manage or deal with them. There was this guy who was my Secretary, engaged in deviant act and I was able to handle him. The other problem I faced was one man selling handout and collecting money from students and using old questions to coach students and I stopped him and paid him off. He was not a staff of the University of Ilorin. After I left GNS, Prof. I. O. Oloyede invited me and the man to face the SS for interrogation and I said I had stopped him from teaching the students. He confessed that I did stop him.

Another challenge was when I appointed Dr. Billy Olajide (now Oba) as the Coordinator of English Language, people in English Department were angry and I told them I had the prerogative to appoint anyone I like. I told them that I appointed people who were ready to work and support the Unit.

Q: With all sincerity and honesty, sir, what can you say about your general experiences in the system, may be in your professional development and promotions?

A: There is no system that is perfect in Nigeria. We have problems and challenges. It is not that it is a smooth ride. You people are witnessing an era where there is no rancour about election of Deans. During our own time, it was like a war. It stopped during the time of Prof. Lawal. Now there is no cause for anybody fighting because you want to be Dean. There is no way a Dean can singularly say a lecturer cannot be promoted because he was not voted for, because there is the *Faculty Promotion Paid* that can intervene if anyone is victimized either by the Department or individual by giving low scores to papers submitted for promotion. The University also has checks and balances, to control abuse. If someone is not promoted, you can request for your assessment. When we were at Junior level, there was little or no mentoring.

This mentoring issue we were talking about, we were on our own unlike now when professors mentor the junior ones.

Q: With your experiences, sir, what advice would you give to young educators especially Mathematics educators?

A: I advise them to work very hard and do more mathematics courses so that they can have the opportunity to diversify. They should learn to work with others and not be a island to themselves. They should shy away from plagiarizing other people's work because the era is gone in view of advancement in technology for detecting such. Also, they should avoid patronizing predatory journals. Things have changed in terms of salary when my take home was about ₦200 only. The situation is better now. There is no room for sorting and engaging in sales of handout. They should stay away from any form of misconduct.

Q: As you are about leaving the university system, what advice will you give to the Administration?

A: The Administration should take care of the Departments. The Federal Government says that they have given a lot of money to the universities. In view of that, Departments should be adequately funded. For instance, we have been fighting for a Mathematics laboratory; it is quite long that the Department of Science Education had requested for Laboratory for each of its programmes as a requirement for accreditation, but of recent, only one was given for all the programmes. On the issue of admission, the Department should be allowed to do the selection because the Department knows better the candidates that are eligible to offer Mathematics. This is because, some students accept to study Mathematics, because they did not want to leave the University. Initially, many of them wanted to study Engineering, Medicine and so on, while some with NCE certificates have wrong combinations which may not qualify them to study Mathematics. For instance, a candidate studied Computer/ Biology in NCE and was given Mathematics/Education. How can such a person cope with Mathematics education? The student spent six years and can not graduate. I advise that selection of eligible candidates should be done by the Department.

Q: What will you sir, continue to remember the Department for especially the staff?

A: In my own way of looking at everybody; I do study those who are ready to work and those who are not ready to work. Do not be anonymous, be visible. If you have any challenge, talk to the senior colleagues. I know many of you are hard working. Some listen, some do not. But I have never had anybody extorting money from students. You are all great!

FOREWORD

I am happy for this great privilege granted me to write this prologue for a Book of Readings in honour of Professor Michael Olubusuyi Fajemidagba. He is retiring from the services of the University of Ilorin, Ilorin, Nigeria, on 2 February 2018, after a meritorious service spanning over four decades. I wish to congratulate Professor Fajemidagba on this well-deserved honour.

Professor Fajemidagba has contributed immensely to Mathematics Education at the University of Ilorin as a pioneer, in particular, and to humanity, in general. He rose through the ranks to become a big name in Mathematics Education in Nigeria and globally, and he was the only Mathematics Educator at the University of Ilorin for a period of about two decades.

He is a highly respected scholar with many years of academic and administrative work experience. He served the University of Ilorin and its immediate communities in different capacities. His guidance and mentorship have inspired many crops of scholars, some of who have contributed to this book project. His efforts in uplifting the standard of Mathematics Education in Nigeria and worldwide are highly commendable.

The Coordinators of the book project designed it to serve as a legacy to sustain his vision and mission for qualitative Mathematics Education in Nigeria, and acknowledge his achievements. The Book of Readings covered, coincidentally, the areas of Mathematics Education where Professor Fajemidagba held sway for over four decades of his career. In addition, the subheadings coincided with the traditional areas of legitimate scholarship that he assisted to fashion out, over a long period, in the Department of Science Education.

It is commendable that the contributors to this Book came from far and near, with interesting and useful papers. The foci of the contributions are clearly in the areas of Mathematics Education in Nigeria that had received research attention, while at the same time pointing up areas that require further attention. The areas that received great attention are interactions of mathematics and other science subjects, mathematics curriculum planning and development, mathematics phobia, mathematics teaching and learning, mathematics enrolment and students' performance in mathematics, Piaget's epistemology, and the new constructivist movement, and applications of indigenous games and practices in mathematics teaching and learning.

Mathematics Educators may need to lead the way in analyzing interconnections of mathematics and other disciplines, since educators consider mathematics as a language for these disciplines. In this book, more non-mathematics educators focused attention on the interactions of mathematics and other school subjects. The papers on Piaget's epistemology are a personal tribute to Professor Fajemidagba whose research works largely had as a basis, the epistemology of Piaget.

The paucity of contributions in the area of Mathematics Education Policy, in this book, suggests that the area is an important one on which mathematics educators need to focus future research attention. Future researches in mathematics education may require more built-in advocacy to influence policy directions in Mathematics Education in Nigeria. In addition, applications of indigenous knowledge to the teaching and learning of school subjects seem to be gaining research attention worldwide. Mathematics educators may wish to key into this area for the benefit of humanity.

I hereby wish to recommend this book to all education students, and educators, alike because it will serve, no doubt, as a reference document for mathematics education. It is a worthwhile legacy in honour of Professor Michael Olubusuyi Fajemidagba and his life and times in the University of Ilorin, Ilorin, Nigeria.

Happy reading.

*Prof. Isaac Olakanmi Abimbola
Department of Science Education,
Faculty of Education,
University of Ilorin,
Ilorin, Nigeria.*

PREFACE

The thought of publishing this book emanated from the desire to sincerely appreciate Professor M. O. Fajemidagba for his record of distinction in the field of Mathematics Education and in other fields and capacities. The distinguished scholar transformed the Department of Curriculum Studies and Educational Technology, now known as Department of Science Education during his two tenures as Head of Department to a highly respectable and enviable one. The quality of his services as Director General Studies Unit, Director, Technical and Entrepreneurship Center, Chairman, Students' Disciplinary Committee, among others are commendable. His love for hard work, honesty, and firmness mark his uniqueness among his peers in the teaching profession. At different levels, he assisted in transforming the administration, the standard and the make-up of different Units of the University to a world class status. His name will forever remain in the annals of the University of Ilorin.

The Mathematics Educators in the Department of Science Education, University of Ilorin, whom Professor Fajemidagba has mentored, felt that this great man should be honoured on his exit from the University of Ilorin. Therefore, in recognition of his numerous achievements, a call for chapter contributions was sent out on 28th May, 2017. The responses were impressive and this led to the production of this festschrift. Academic issues that are related to Mathematics Education at different levels of the Nigerian Education system constituted the sub - topics from which chapter contributions were made. The contributors are scholars of high repute and there is no doubt that their contributions will be useful to Mathematics Education students, Lecturers and other stakeholders.

The book has thirty chapters classified into seven sections (A- G) underneath. Section A is on Mathematics Education Policy; Section B: Mathematics Teaching; Section C: Mathematics Learning; Section D: Mathematics Teacher Education; Section E: Mathematics Education Curriculum Development; Section F: Mathematics Education Research; and Section G: Others. One(1) chapter is on the policy on primary school mathematics education; seven (7) chapters on Mathematics Teaching; eight(8) chapters on Mathematics Learning; four(4) chapters on Mathematics Teacher Education; Three (3) chapters on Mathematics Education Curriculum Development; Four (5) chapters on Mathematics Education Research; and Two (2) chapters are on others not directly addressed to Mathematics Education.

Issues discussed in Section A include, the Federal Government policies on Mathematics Education at primary school level and effective teaching of primary school Mathematics for National Development. In Section B, Innovative strategies for effective teaching of Mathematics were covered together with applications of Mathematics in other disciplines including science. In Section C, the psychological basis of Mathematics Education, the relevance of psychological theories to Mathematics Education and various learning modes were highlighted. In the same vein, Section D addressed the challenges of Mathematics Teacher Education in Nigeria and effective strategies

towards improving Mathematics Education. Also, Section E is on problems of Curriculum Development and Curriculum Delivery of secondary school Mathematics Education and its implications for sustainable development in Nigeria while Section F covered research methods and various modes of data analysis. Lastly, Section G contained chapters that are not directly related to Mathematics Education but were considered useful.

The book has up-to-date information on Mathematics Education in Nigeria and it will be useful to all education stakeholders.

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Glory be to the Almighty God for the publication of this Festschrift. Sincere appreciation goes to everyone who has contributed in one way or the other to the successful publication of the festschrift. Specifically, the efforts of Prof. I. O. Abimbola, Prof. L. A. Yahaya, Dr. Modupe M. Osokoya, Dr. Mary O. Esere and Dr. G. Bello in ensuring a thorough review of manuscripts are well acknowledged. Dr. T. A. Alabi who did the English Language review of the festschrift is also appreciated. Dr. J.O. Ayinla is also acknowledged for his unflinching support. Sincere gratitude goes to colleagues and some Ph.D. Mathematics Education supervisees, who gave financial support for the production of the festschrift and the Unilorin Press for prompt production. May the Lord reward them all

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CHAPTER SEVEN

RELEVANCE OF MATHEMATICS EDUCATION TO ARTS EDUCATION: IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT

A. F. OYELADE, Ph.D.

Introduction

Education is the aggregate of ideas, methods, institutions, facilities and personnel designed and developed by the society to teach its members how to go through life by doing or nursing and realizing set goals (Bojor, 2013). This article explores the meaning of Mathematics Education, Arts Education and the implication of the relevance of Mathematics Education to Arts Education for Sustainable Development. A careful exploration of the meaning of Mathematics Education suggests that Mathematics Education is important because Mathematics is an indispensable tool in the study of sciences and humanities (Salman, 2005).

Also Arts Education enables an individual to be empowered with creative skills that widen the base of participation in the society, create jobs, self-reliance and identity (Bojor, 2013). Mathematics Education is relevant in Arts education since there is hardly any sphere in life that does not require the use of numbers. This paper also discusses sustainable development as the development that meets the need of the present without compromising the ability of future generation to meet their own needs. It is a development that was established to ensure the long term stability of a nation's economy and environment (Dernbach, 2003). The importance of a stable economy of a nation cannot be overemphasized; hence, the implication of the relevance of Mathematics Education to Arts Education for sustainable development was also discussed in this article.

Usefulness of Mathematics and Mathematics Education to Human Existence

Mathematics has earned itself the focus of researchers in the field of Mathematics and Mathematics Education due to its importance in day to day activities. It involves calculations in the area of arithmetic, algebra, geometry, and trigonometry (Nkwocha, 2016). Mathematical Education is important in science because the sciences dwell so much on mathematical foundations of propositions to arrive at logical conclusion. Whether in Physics, Chemistry, Biology, Space Science, Economics, Military or Health Sciences, mathematical calculations are of great importance for preliminary, progressive and conclusive decisions.

Furthermore, guided missiles in military science cannot function in the exact and expected manner without thorough mathematical calculations all through. The same can

be said of health matters in terms of drugs to be used by patients and even time for operation on patients. Also, micro and macro-economics for societal, industrial and social development cannot be done exactly without thorough involvement of mathematical calculations.

Thus, Mathematics is a crucial basis of the sciences and an essential tool for sustainable development (Salman, Ameen & Adeniji, 2017). It is fundamental and of progressive need. Basic and Applied Mathematics are therefore necessary to be thought to all learners, in fact to all citizens of all societies since it is fundamental to human existence. Every individual needs to do his or her own financial calculation in terms of financial transactions, income and expenditure. In the same vein, the society as well as the nation has to do fiscal budgetary calculations. All these need Mathematics and Economics dimension, hence the importance of Mathematics.

Mathematics Education does not only involve the teaching and learning of Mathematics but also deals with curriculum issues, teacher preparation, innovative strategies for teaching Mathematics and evaluation process among others (Salman, 2017). In view of the importance of Mathematics, it is therefore imperative to educate everybody on basic and applied Mathematics. Thus, Mathematics education is important for the society from the elementary level to the tertiary level of education. The acquisition of numerical knowledge would help provide enlightenment; for socio-economic development of individuals and the society in general.

Importance of Arts Education

Education in Nigeria is vital. It is an engine house that services the nation. The role of Arts in education is also an important aspect that enables proper functioning of this engine house (Bojor, 2013). This reason stems from the fact that Arts Education enables students to become creative art practitioners (Ajibade & Elemi 2012). Students in Arts Education learn to develop the necessary imaginative, intellectual, theoretical and practical skills to equip them for continuing personal development and professionalism (Ajibade & Elemi 2012).

Art education differs from Mathematics Education in the sense that Arts Education involves areas that include History, Religion, Language, Performing Arts, Fine Arts, Philosophy and related dispositions which are outside the natural sciences and social sciences (Barnes, 2009). Also, while sciences which have Mathematics as a basic feature are predisposed to exact calculations and experimentation; the Arts are predisposed to language issues, religious concerns, artistic displays, thoughts (particularly deductive reasoning), cultural matters (particularly moral basis of actions), aesthetic matters and historical realities.

Facts of history in Arts Education are of importance for knowledge and derivation of present realities and future tendencies. Religious revelations in the past may or may not be repeated today but they have relevance for today's happenings and future tendencies

(where revelations are genuine). Religious histories of notable certainties constitute food for thought in terms of present happenings and possible future happenings.

Furthermore, Language is taught in Arts Education and is used to convey ideas. It is a way of communication. Without communication, human beings cannot relate effectively with one another. Scientific, technological, religious, artistic and mathematical ideas cannot be conveyed from one person to another without the use of language. Hence, language in Arts Education bridges the gaps between fields of education such as Mathematics, Sciences and Arts. The language may be in terms of scientific expression; musical and digital signs; technological applications (for instance in information and communication technology). The language may also be in terms of religious worship expressions limited to religious situations.

Thus, everybody also needs to be educated in certain basic features of the arts; for instance, in the issues of language for the purpose of communication with fellow human beings, as mentioned above. In fact, the more language skills one has in various languages, the more one is predisposed to communicate with more people, and the more one is likely to know about others.

Indeed various disciplines also have various professional technical language used in the course of professional conduct, as highlighted above. Medicine has professional terms used by medical doctors in the course of examination and treatment of patients limited only to the professional and related professionals (such as nurses, pharmacists etc). Similarly, musicians, poets, politicians, philosophers, beauticians, nutritionists and all people involved in one cultural activity or another use specific language terms to convey specific ideas and general language terms to convey general ideas

Furthermore, language, which is largely in the realm of arts, deserves to be given specific attention in terms of ensuring that everybody is educated in the rudiments of language from the elementary level to certain time at the tertiary level of education. No wonder, the use of English for English speakers as second language is considered to be a mandatory course as part of General Studies Course requirement in the tertiary educational institutions in Nigeria. Arts in Education are therefore as important as Mathematics in Education and the Sciences. The two areas are somewhat complementary (that is, Mathematics Education and Arts Education).

Relevance of Mathematics Education to Arts Education

Mathematics has been described as the queen and servant of all disciplines considering its usefulness to other subjects and fields of study such as arts, social sciences, religion, mysticism and commerce (Fajemidagba, 1986 & Adegboye, 2003). Salman (2005) also described Mathematics as an indispensable tool in the study of science and humanities. These submissions suggest the importance of Mathematics Education in the field of Arts. In the same vein, Uwadiae (2017) submitted that Mathematics knowledge is used in the operation of mobile devices, architecture, arts, money, engineering, research,

commerce, provision of social and community services, medical services, sports as well as government policies and planning among others.

Furthermore, Mathematics Education as stated earlier, gives knowledge of calculation of various forms such as; arithmetic, algebra, geometry, etc. It gives knowledge of pure and applied calculation that foster peoples' transaction in personal finances and other finances. It gives micro and macro-economic knowledge, as well as knowledge in various scientific dispositions. Mathematics Education also gives knowledge in arts as well, for instance, it enables people in history to be conscious of periodisation, people in religion are conscious of times and tides and people in language are conscious of the dynamism of language. There are significant features of impact of Mathematics in other areas of Arts Education too. Arts Education needs to evaluate success or failure of lessons, lectures, method, strategies, and materials used in lessons and lectures. Arts education also needs to measure the outcomes and achievement of some other important educational pursuits. Some of these require the knowledge of Mathematics and Mathematics Education.

Finally, educational technology materials that facilitate teaching and learning are products of science and technology which generally have mathematical basis in their production and application. Educational technology instructional materials are used in all types of education including arts education. Thus, pure and applied Mathematics Education has direct and indirect relevance to Arts during the process and outcome of education.

Meaning and Goals of Sustainable Development

Among the many definitions of sustainable development is that which meets the need of the present without compromising the ability of the future generations to meet their own need (Dernbach, 2003). Sustainable development is a concept that refers to development where emphasis is shifted from short term economic gains to a more long term approach where there is balance between economic, social and environmental consideration. Sustainable development requires an integrated approach to decision-making linking the economy, the environment and society rather than a piecemeal approach.

Also, sustainable development can be defined as the organizing principle for meeting human development goals while at the same time sustaining the ability of natural resources and ecosystem services upon which the economy and society depend (Wikipedia, 2017). The desired result is a state of society where living and conditions and resource use continue to meet human needs without undermining the integrity and stability of the natural system

Sustainable development in this chapter would be discussed in terms of United Nations Charter on Sustainable Development. The Charter (the principles, purposes and duties) on sustainable development by the United Nations of the 25th September 2015 (United

Nations, 2015) is a declaration that the world would be developed in a sustainable manner by achieving the following goals by 2030:

1. End poverty in all its forms and dimensions (the three dimensions of poverty are economic, social and environmental).
2. Eradicate hunger.
3. Ensure healthy lives.
4. Ensure inclusive and equitable quality education.
5. Ensure gender equality in terms educational, economical, political, public lives and other progressive matters.
6. Ensure availability and sustainable management of water for all.
7. Ensure access to affordable and sustainable modern energy for all.
8. Promote sustainable economic growth, full (and decent) employment for all.
9. Ensure resilient infrastructure and promote innovation.
10. Reduce inequality within and among countries.
11. Ensure that cities and human settlement are safe.
12. Ensure sustainable consumption and production patterns.
13. Combat climate change and its impacts.
14. Ensure sustainable use of oceans, seas and marine resources for development.
15. Ensure sustainable management of forests and combat desertification and land degradation.
16. Promotes peaceful societies where there will be access to justice for all.
17. Strengthen the means of implementation of the goals highlighted above through revitalizing global partnership for sustainable development (UN, 2015).

All the goals stated above as United Nations agenda for sustainable development of the world by 2030 are stated in terms of 17 Sustainable Development Goals and 169 targets. The sustainable development agenda is accepted by all countries and applicable to all (UN, 2015). No doubt the goals (values) are good. They are a follow up of the United Nations Millennium Development Goals (MDGs) and seek to complete what those goals did not achieve, particularly in reaching the least developed countries (UN, 2015).

Moreover, the Millennium Development Goals appear to be fewer (8 goals) including: poverty eradication, ensuring good health, education, food security and nutrition, gender equality, environmental sustainability and global partnership for development. The sustainable development goals appear to have a wider coverage adding: economic, social and more environmental goals, peaceful and inclusive societies and defining means of implementation of the goals (UN, 2015).

The MDGs could not achieve as much as expected by the United Nations, particularly in the least developed countries within the given 15 years (that is 2000–2015); thus the need to sustain the tempo and add more goals for another 15 years 2016-2030 for sustainable development of the world (with effect from 1st January 2016) (UN, 2015). The implementation of the agenda concerns all nations and all peoples. However, it would respect different national realities, capacities and levels of development and

national policies and priorities. The implementation would also recognize transfer of environmentally sound technologies to developing countries on favourable terms, including on occasional and preferential terms mutually agreed. There would be need to intensify efforts to strengthen statistical capacities in developing countries particularly African countries, least developed countries, small islands, developing states and middle-income countries (UN, 2015).

The United Nations Declaration indicates a call for all nations "all peoples" to work together on the agenda to end poverty in 2030 and make great history; just as earlier generations of the world leaders 70 years ago (1945) came to form the United Nations Organisation from the ashes of war and division and thereby channel the path to world peace, dialogue and international co-operation (UN, 2015). Many of the outcomes of the details of policies, experiences and actions would be communicated through online platform. However, the United Nations charter respects each country's policy space and leadership to establish and implement policies for poverty eradication and sustainable development (UN, 2015).

This last factor however, may give corrupt leaders who may choose to remain largely indifferent to the Sustainable Development Goals of the United Nations the tendency to remain indifferent to the goals – as it is the case with some corrupt leaders in some developing countries.

Goal 16 of the Sustainable Development Goals (SDGs) whose details include: "significantly reduce illicit financial and arms flow, strengthen the recovery and return of stolen assets and combat all forms of organized crime; substantially reduce corruption and bribery in all their forms;....provide legal identity for all including birth registration (UN, 2015, p25)" may have little or no meaning to corrupt leaders, and if such leaders are respected in spite of their non-compliance tendencies, they would not pursue the goals effectively. Thus, a country's policy space and leadership need to be monitored and sanctioned where there is evidence of consistent non-compliance with the SDGs.

Finally, it can be seen that the SDGs are intended to foster prosperity, peace and partnership for all peoples of the world in a resilient manner by 2030. These are good. They are aversion to violence, inhumanity and degradation of the planet earth. But can these be achieved through human efforts alone in spite of the world's sophisticated science and technology; and in spite of the plea for dialogue rather than war?

This question is important to be able to see if the sciences and technology at the disposal of man and the desire to pursue dialogue and cooperation are all that we need for sustainable development, or whether we also need a concern that is more resident in the arts than in the sciences and Mathematics. It appears that man needs a concern that is more resident in the arts and Mathematics for the sustainable development. That concern is God.

God is not in Mathematics and cannot be in Mathematics Education, nor can He be said to be in the sciences and science education. But God is a concern in the arts, particularly in religious studies. Morality is another concern; this is also more in arts and in arts education than in Mathematics and Mathematics Education. Thus, the issues of God and morality may have to come up stage if sustainable development of the world would materialize fully. This is to state that sustainable development might not materialise fully without the consideration of God that religious studies say is the author of life (man, non-humans, the world and the universe) and morality. No matter how much one dialogues with a morally bankrupt political leader, he may remain adamant about considering great reduction of corrupt practices in his country. Such a leader needs moral development and fear of God to be able to reason in line with poverty eradication dialogue.

In effect, Mathematics, science and technology are good; in fact very good concerns in the efforts to achieving sustainable development; but they are not sufficient. indeed they are deficient without acknowledging the source of life and moral faculty (God) in the issues of human peace, progress, prosperity and partnership.

Implications of the Relevance of Mathematics Education to Arts Education for Sustainable Development

Mathematics in Arts Education is relevant to sustainable development in terms of the concept of sustainable development discussed in this chapter, that is, in terms of United Nations Charter on sustainable development of 25th September 2015. The Charter contains declaration of 17 goals and 169 targets to eradicate poverty, ensure peace, prosperity, equality and progress of all nations and peoples of the world by 2030 (UN, 2015).

The Charter enlists the use of science and technology, statistics (UN, 2015:27) and online platform for the processing of issues and presentation of progress and achievement throughout the world. In this connection the charter pledges to intensify training of developing nations in the use of technology facilities to ensure prompt delivery of information and materials that would help in realization of the 2030 target.

The field of Arts cannot survive without science and technology resources. These resources reflect the application of Mathematics. In order to achieve the goals of sustainable development, materials, statistical processes and online platform are technological tools that are necessary in actualizing these goals. However, all these products and processes manifest Mathematical basis. This suggests the implication of the relevance of Mathematics and Arts Education to sustainable development in terms of the Charter of sustainable development by the United Nations.

As stated earlier, Mathematics Education (pure and applied), even as expressed in science and technology is not sufficient for sustainable development of the world. The world needs Mathematics Education, pure and applied in science and technology as well

as in Arts Education. For instance, as contained in moral development processes and fear of God that features in philosophy and religious studies.

Mathematics, science and technology, statistics, moral development and fear of God need to feature in the quest of the nations and peoples of the world to attain sustainable development by 2030. As stated earlier, a morally bankrupt leader is not likely to be convinced to see reason with the United Nations in real terms in matters of eradication of poverty and ensuring a corrupt free society. Fear of God could however force such hitherto corrupt leader to change his corrupt disposition and embark on the agenda of eradication of poverty, ensuring peace, progress and corrupt free society.

Conclusion

This chapter has discussed the importance of Mathematics Education, Arts Education, sustainable development, relevance of Mathematics Education to Arts Education and its implications for sustainable development. It was seen that Mathematics Education is important and relevant to Arts Education. This overall relevance is of significance in realizing the goals of sustainable development. Therefore, it is worthy of note that Arts Education complemented by Mathematics Education helps to achieve sustainable development desired by the United Nations in 2030. Finally, it is seen that moral development and fear of God are very crucial for realistic eradication of poverty and corrupt tendencies by morally bankrupt leaders and people.

Recommendations

Mathematics Education which is basic to science and technology is relevant to Arts Education and sustainable development. However, because Mathematics Education (pure and applied) is not a sufficient requirement for sustainable development of the world, it is recommended that Arts Education be given more relevance than it is hitherto given in sustainable development processes of the United Nations, particularly in terms of pursuit of moral development of people and fear of God.

Moral development and fear of God by leaders and people of the world would ensure realistic use of scientific and artistic knowledge and devices for the attainment of sustainable development that the world desires by 2030.

References

- Adegboye, A. O. (2003). An investigation into secondary school students' performance in SSCE Mathematics. *Lafiagi Journal of Science Education*, 5(1&2), 84 – 89.
- Ajibade, B. & Elemi, N. (2012). The importance of visual illustrations in recommended primary and secondary school textbooks in Calabar. *Journal of Educational and Social Research*. 2(1), 161 – 170.
- Barnes, B. (2002). *Art in Encarta*. Washington: 1993-2008 Microsoft Cooperation.

- Bojor, B. E (2013). The role of arts education in Nigeria. *African Journal of Teacher Education*. 3(1), 92 – 106
- Dernbach, J. C. (2003). Achieving sustainable development: The centrality and multiple facet of integrated decision making. *Indiana Journal of Global Legal Studies*. 247-285
- Fajemidagba, M. O. (1986). Mathematics word problem solving: An analysis of errors committed by students. *The Nigerian Journal of Guidance and Counseling*, 2(1), 23 – 30.
- Nkwocha, E. O. (2016). Mathematics education for sustainable development, security system and self-employment in Nigeria. *ABACUS*. 41(1), 41-50.
- Salman, M. F. (2005). Teachers' identification of the difficulty levels of topics in the primary school curriculum in Kwara State. *The Journal of Mathematics Association of Nigeria*, 30(1), 20-29.
- Salman, M. F.; Ameen, S. K. & Adeniji, S. M. (2017). *Mathematics education: A tool for sustainable development and graduate employability*. A paper presented at the 3rd Association of West African Universities International Conference held at Niamey, Niger Republic From 17th – 21st September, 2017.
- United Nations (UN). (2015). *Transforming our world: the 2030 agenda for sustainable development*. New York: United Nations:
<http://daccess.ods.un.org/access.nsf/Get?Open&Ds=A/RES/70/1&lang=E>
- Uwadiae, I. (2017). *Mathematics as a key to sustainable change in growth and development*. Keynote Address at the 54th Annual Conference of MAN held at Yaba College of Technology, Yaba, Lagos on 22nd August 2017.
- Wikipedia, (2017). *The free Encyclopedia*. Retrieved from
http://en.m.wikipedia.org/wiki/sustainable_development