

**CONTEMPORARY ISSUES IN
SCIENCE, TECHNOLOGY, ENGINEERING,
ARTS AND MATHEMATICS
TEACHER EDUCATION IN NIGERIA**

**A FESTSCHRIFT IN HONOUR OF
PROFESSOR ISAAC OLAKANMI
ABIMBOLA**



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PROFILE OF PROFESSOR ISAAC OLAKANMI ABIMBOLA

Isaac Olakanmi Abimbola is a Professor of Science Education at the Department of Science Education, Faculty of Education, University of Ilorin (Unilorin), Ilorin, Nigeria. He was born on 2nd August 1948 at Òdò-ijèsà, in Àtákùnmòsà East Local Government Area of the State of Osun, Nigeria.

He is a professionally trained and certified teacher of over fifty years teaching experience. He has taught at all levels of education. In addition, he is a certified Applied Scholastics International Master Instructor.

He was educated at St. Bartholomews Anglican Primary School, Òdò-ijèsà; L. A. Secondary Modern School, Oké-Oyè, Ilesà; Wesley College, Ibadan; The University of Ife, Ilé-Ife, Nigeria; The University of Wisconsin-Madison, Madison, Wisconsin, USA.

His research is in the area of student misconceptions and alternative conceptions in biology. It focuses on how students can learn with perfect understanding. This is to enable them apply their knowledge in problem solving. He has published several scholarly articles in reputable home-based, national, and international journals. In addition, he has published many books on Curriculum and Instruction, Integrated Science, Biology, History and Philosophy of Science, Research Methods, and Study Technology.

Professor Abimbola has supervised several theses and research projects of many science teachers and educators holding important positions in Nigeria.

He has been External Examiner to several Colleges of Education and Universities in Nigeria. He has been External Assessor of Ph.D. candidates theses in many Nigerian Universities. He has been External Assessor for promotion of senior academics in Colleges of Education, higher education regulatory agency and Universities within and outside Nigeria. He is a regular participant in NUC and NCCE Accreditation exercises. He is a regular presenter of research papers in local, national, international conferences and capacity building programmes. He has served as Member of Editorial Boards of several national and international Journals. He has delivered awareness-training programmes on Study Technology to many secondary school and university students and teachers. He is a member of many professional associations in science education.

Professor Abimbola has been Visiting Professor to Michigan Technological University, Houghton, Michigan, USA, and Tai Solarin University of Education, Ijagun, Ijebu-Ode, Ogun State, Nigeria.

He was previously a primary school teacher and later a Headmaster, Methodist School, Papá, in Olójuńrò Area, Ibadan Less-City (Jan-April, 1969); Classroom teacher, Wesley College Practising School, Elékúńrò, Ibadan (April 1969-September 1971); NYSC teacher, Teachers College, Bama, Borno State (August 1975-June 1976); Education Officer II, Ministry of Education, Ibadan, Oyo State July-12 September 1976); Professor Abimbola has been in the service of the University of Ilorin for the past 42 years; Assistant Lecturer - Professor, University of Ilorin, Ilorin (13 September 1976 — 1 August 2018); He was the first democratically elected Head of Department of Curriculum Studies and Educational Technology, University of Ilorin, Ilorin, Nigeria (1 August 1999 — 28 February 2002); Provost, Osun State College of Education, Ilesa, Osun State, Nigeria (1 March 2002 — 28 February 2006); Foundation Director, Centre for Research, Development and In-House Training (CREDIT), Unilorin; First Dean, Postgraduate School from the Faculty of Education, Unilorin; Foundation Research Manager, Faculty of Education, Unilorin.

Professor Abimbola is leaving rich legacies for us, and in us, in his positive personal attributes of integrity, scholarship, hard work, thoroughness, professionalism, and his useful books. He is leaving behind important research legacies in the area of study technology as represented in misunderstood words, situations, and symbols, and perfect understanding. We shall continue to remember his advocacy for multiple-choice testing as a panacea for students learning difficulties that may prevent perfect understanding.

Professor Abimbola is happily married with children and grandchildren.

He loves photography and many varieties of music.

Biology Education Group (2018)

FORWARD

Research in science teacher education are on-going world-wide as a result of advances in knowledge, changing policies, evolving teacher education standards and professionalism, and the challenges of globalization and internationalization of education. Many challenging issues have arisen that need to be better understood and addressed in the pre-service science, technology, engineering, art and mathematics (STEAM) teacher education in Nigeria. The understanding and new insight will help to enhance and to continually improve the quality of STEAM teacher education. Professor I.O. Abimbola has devoted greater part of his academic career through research and teaching to the development and improvement of science teacher education. It is based on Professor Abimbola's immense contribution to development of science teacher education that the theme: Contemporary Issues in Science, Technology, Engineering, Art and Mathematics (STEAM) was chosen. The theme is for STEAM educators to reflect on contemporary development, evolving issues and challenges in the STEAM teacher education that could lead to evolving quality and innovative ways to enhancing pre-service STEAM teacher education for the 21st century.

This festschrift is in context of the foregoing. It is published under the Editorial Consultant of the Biology Education Goup, Department of Science Education, University of Ilorin, Nigeria, in honor of Professor I.O. Abimbola, a renowned Science Teacher Educator who retires 1st August, 2018 after 43 years of meritorious academic service; teaching, research and community engagements nationally and internationally.

Sixty-eight articles on the theme and the sub-themes were received from authors and subjected to thorough peer review process. Thirty-six (36) of the articles received scaled the peer review standard. What is therefore published in this festschrift are those articles that meet the required standard and addressed those contemporary but significant issues on STEAM teacher education in Nigeria. The articles therein are focused on and accordingly classified under sub-themes that address issues on Quality of STEAM Teacher Education, Teacher Education Curriculum, Teacher Education and Professional Development, Teaching and Learning, Instruction in Teacher Education, Policy and Teacher Education, Gender and STEAM Education, etc. A special section on compendium of Professor Abimbola supervised Master Dissertation and Doctor of Philosophy Thesis in Science Education revealing his significant contribution in aspect of research mentorship is presented as important component of this book.

The ideas, new narratives, research findings, suggestions and recommendations expressed and advanced by the authors have addressed critical issues for practice and have open up new enquiries into STEAM teacher education that should be focus of further inquiries by STEAM teacher educators.

Considering this book as significant resource book for STEAM teacher education, we recommend it to all teacher education institutions, National Universities Commission, National Commission for Colleges of Education, and other agencies involve in STEAM

teacher education curriculum development, STEAM teacher educators and STEAM pre-service students and all knowledge seeing individuals interested in STEAM teacher education.

The Editorial Team highly appreciates all the authors for their valuable intellectual contribution to this book and to the Academic Board of the Faculty of Education, University of Ilorin, for its quality input and support. To the Consulting Editors your diligent and thorough review process that attest to the quality of the book is immensely appreciated.

Professor M.T. Mustapha

PREFACE

In keeping with the global academic tradition whenever the retirement of an erudite scholar is celebrated by the academic community, the Biology Education Group, Department of Science Education, University of Ilorin, Ilorin, Nigeria, produced this festschrift in tribute to Professor Isaac Olakanmi Abimbola. He is a professionally trained and certified science teacher, as well as, a Certified Applied Scholastics International Master Instructor whose teaching experiences across all levels of education in Nigeria span more than half of a century. Professor Isaac Olakanmi Abimbola who has announced his retirement from the services of the University of Ilorin, Ilorin, Nigeria, after 42 years of active service, is one of the pioneer staff of the University and the Department of Curriculum Studies and Educational Technology (CSET), now known as the Department of Science Education. He is the first Professor of Biology Education in the University. His research interest is in the field of student learning, especially student misconceptions and alternative conceptions in biology, with a special focus on how students can learn with perfect understanding. His scholarly contributions have significantly enriched Biology Education.

Although he was born during the analog era, Professor Isaac Olakanmi Abimbola successfully bridged the digital generation gap to become a leading proponent and prolific user of modern digital technology in teaching and learning in the Faculty of Education, University of Ilorin, Ilorin, Nigeria. He has been Visiting Professor to many universities, such as Michigan Technological University, Houghton, Michigan, USA, and Tai Solarin University of Education, Ijagun, Ijebu-Ode, Ogun State, Nigeria.

He is keenly interested in his students' research works, provides prompt feedbacks and technical assistance. However, working with Professor Isaac Olakanmi Abimbola can sometimes be very stressful, especially if you compromised standards, paraded poorly structured ideas, outdated information, and if you are always reporting efforts, rather than products. He is, however, ever ready to purge you of your misconceptions and alternative conceptions to enable you gain meaningful understanding of issues and problems under focus. For him, everything is knowable and can be done perfectly well; hence, he continuously sets high standards and exhibits zero tolerance for laziness and carelessness. The success of his students is the cornerstone of his engagement with the students. His invaluable guidance and leadership by example, in high quality service delivery, has significantly shaped the professional development of his students and other professors often seek his creative advice.

The theme of this festschrift is Contemporary Issues in STEAM Teacher Education in Nigeria. STEAM is a new acronym for Science, Technology, Engineering, Arts, and Mathematics. It is in recognition of Professor Isaac Olakanmi Abimbola's invaluable contributions to the field of Biology Education, that his professional colleagues, students and acquaintances contributed their original academic works to this festschrift. These contributors spread across every level of the nation's education ladder, across the

nation and even outside the nation. There are thirty-eight chapters organized under seven sections in the festschrift.

The focus of the seven chapters under Section A is on contemporary curricular issues in teacher education in Nigeria. There are also seven chapters in Section B focusing on issues concerned with teacher education and teacher professional development programmes in the nation. Ten chapters that focus on learning were under Section C, while there were only two chapters in Section D, the chapters highlighted issues related to instruction in teacher education. The next eight chapters constitute Section E. Policy issues in teacher education were discussed in the eight chapters. There were only two chapters in Section F, which addresses the need to promote guidance and counseling services in teacher education in Nigeria. A compendium of Master Dissertation and Doctor of Philosophy Theses in Science Education Supervised by Professor Isaac Olakanni Abimbola was organized under Section G.

We, the Biology Education Group, Department of Science Education, University of Ilorin, Ilorin, Nigeria believe that the academic works contributed in this festschrift would extend knowledge significantly in the field of teacher education, especially biology education, to which our esteemed and beloved Professor Isaac Olakanni Abimbola has made remarkable contributions. Teacher educators would remain deeply indebted to him for long.

Ganiyu Bello Ph.D.

ACKNOWLEDGEMENTS

The Biology Education Group, Department of Science Education, University of Ilorin, Ilorin, Nigeria, gives all praises and adoration to the almighty God, for the successful disengagement from active service of our beloved Professor Isaac Olakanmi Abimbola after 42 years of meritorious service. We, pray God to make his retirement a pleasant experience.

We are deeply indebted to his professional colleagues across the nation for their unflinching academic, moral and financially support toward the production of this festschrift. Special thanks go to the outgoing Dean of the Faculty of Education, Professor N.B. Oyediji, incoming Dean, Professor M.F. Salman, the Director of the Institute of Education, Professor L.A. Yahaya. We appreciate the contributions of Professor A. M. Olagunju, and Dr. M. M. Osokoya from the University of Ibadan. In addition, we are grateful to Professor Isaac Olakanmi Abimbola's students and acquaintances for their financial and academic contributions toward the production of this festschrift. We equally, appreciate the invaluable contributions of all the Staff and students of the Department of Science Education, Faculty of Education, University of Ilorin, Ilorin, Nigeria.

Dr. Mulkah A. Ahmed
Ag. H.O.D Science Education

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PROMOTING SCIENCE, TECHNOLOGY, ENGINEERING, ARTS AND MATHEMATICS WITH STUDY TECHNOLOGY: IMPLICATIONS FOR TEACHER EDUCATION

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Abstract

Study Technology is a system of learning how to learn. The use of Study Technology brings about an understanding that results in the ability to apply what one learns at school, in one's work and in life situations. Attempt is therefore made in this paper to discuss what is Study Technology; the concept of STEAM ; Justification for Study Technology in promoting STEAM; Major barriers to learning, and implications of study technology for teacher education. The paper call on students and teachers to frequently employ Study Technology.

Introduction

STEAM is the acronym for Science, Technology, Engineering, Arts and Mathematics, it evolved from STEM. This occurred as a result of simultaneous growth in knowledge specialization, from ST (Science and Technology), through STM (Science, Technology and Mathematics) to STEM (Science, Technology, Engineering and Mathematics) (Abimbola, 2018). According to McKinsey (2018), the inclusion of the Arts component into STEM make it more fun to learn and approachable to the learners. Also, it makes learners to be fully engaged in learning things by holding their attention to become paramount. For instance, the way social media and internet sites does makes learning to be very interesting. When something like video art tied into code are used by the learner in solving problems and by that creating a new project out of it. Art education allow learners to learn things in a more open-ended way and applicable to real life situation. With the inclusion of Arts component to STEM, it allows technology to be used in real life. These are found in website that uses interfaces design, advertising, product design, usability and a lot of other uses, more importantly in all things that are crucial to STEM learning and careers (Vidcode on Twitter, 2018).

What is STEAM?

This is an educational approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding student inquiry, dialogue and critical thinking (Riley, 2018). With STEAM, the end results are students who take thoughtful risks, engage in experiential learning, persist in problem-solving, embrace

collaboration, and work through the creative process. These are the innovators, educators, leaders, and learners of the 21st century.

What is Study Technology?

Applied Scholastics International (2007) describes Study Technology as “a learning system that produces a greatly improved result when used exactly.” Hubbard, an educator in USA developed Study Technology to help students to truly understand what is being study and essentially how to learn. It consists of tools and techniques that the teachers can use to improve learning rates of students. It can be used to improve students’ ability to understand and apply the knowledge gained in any situation.

Justification of Using Study Technology for promoting STEAM

Study Technology employs principles and strategies that involves guiding student inquiry, dialogue and critical thinking. There are three Principles of Study Technology, namely, (i) Mass (ii) skipped a Gradient and, (iii) Misunderstood Word. When these principles are used appropriately, they can solve any difficulties of learning of STEAM subjects. The justification for using Study Technology is based on the following:-

- Study Technology is an activity based strategy that encourages practical rather than theoretical
- Communication and teamwork are encouraged with “Twinning”
- No verbal communication and too much activity for teacher of Study Technology rather than instructions.
- With activity-based of study technology new discoveries could be achieved because learning and teaching STEAM would be more interesting
- Research has proved that STEAM is still hardly appreciated and productive in Nigeria because it is expensive, but instructions with Study Technology principle, although it may be time consuming, it is not expensive.

Major Barriers to Learning

Applied Scholastics International identified three major barriers to the learner’s study, namely:

- i. Absence or Lack of Mass
 - ii. Too Steep (skipped) a gradient and
 - iii. The Misunderstood Word. The three constitute the 3 principles of Study Technology.
- The 3 barriers to Study are demonstrated in the Figure 1

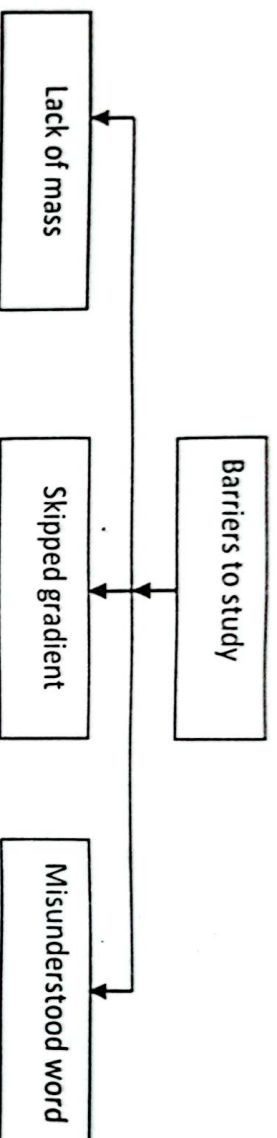


Figure 1: Principles of Study Technology

- i. *Absence or Lack of Mass*: The first principle of Study Technology state that when introducing new concept, it is important to have an example physically present to “get its mass”. If it is not possible to present a physical example, then, a picture or diagram should be provided. According to Hubbard (2005), learning cannot take place without visual aids. Thus, almost every paragraph of a book is accomplished by a picture. To remedy the incidence of the “absence of mass”, the learner is provided with the actual object being studied. It is only when this is not possible that the instructor provides the following as alternatives: pictures, movies, demonstrations, demo kits, clay demos and sketching. This is where Arts could be integrated into STEM to make learning to be meaningful. Reactions that could be exhibited as a result of lack of mass are illustrated in Figure 2

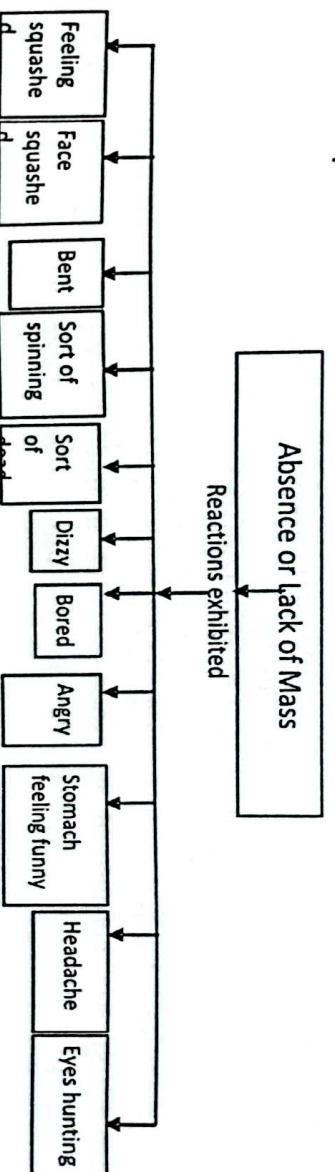


Figure 2: Physical and Mental Reactions Exhibited as a result of Lack of Mass

- ii. *Too Steep Gradient*: When the gradual approach is omitted or jumped, then skipped or too steep a gradient occurs. Gradient is a gradual approach to something taken step by step, level by level, each step or level being part of it. It is also defined as a way of learning or doing something step by step. There are two reactions associated with too steep (skipped) a gradient during a study situation. These are: (i) sort of reeliness and (ii) confused. This is expressed in Figure 3

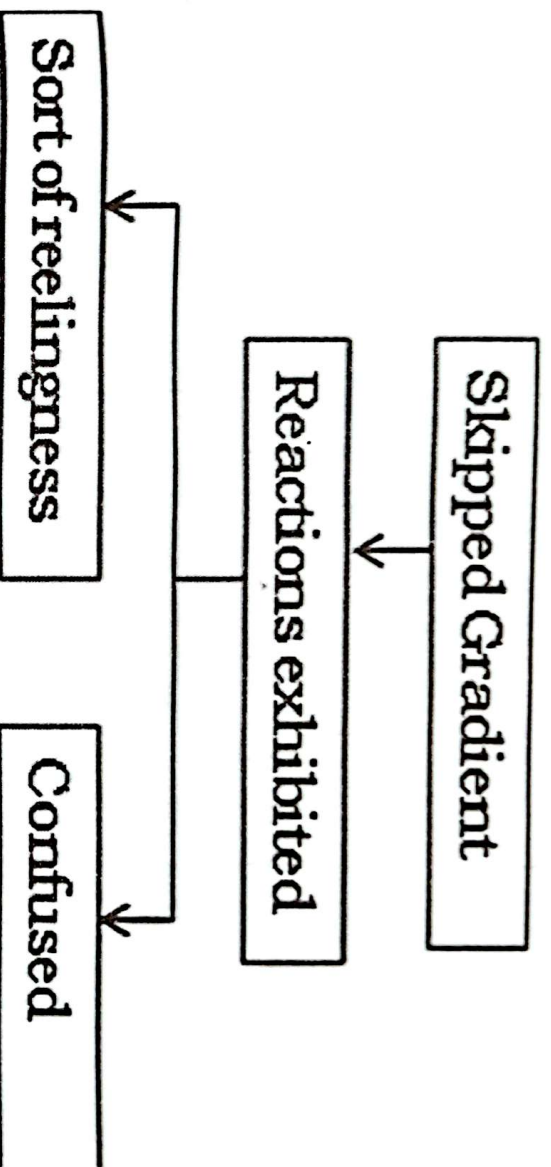


Figure 3: Reactions associated with too steep (skipped) a gradient

In this barrier, the gradient of a learning material is represented by three dimensions, which determine the difficulty of how it would be learned. They are the dimensions of abstractness, complexity and sophistication (Abimbola, 2018). The abstractness of a concept varies from concrete to abstract in terms of its accessibility to observation and visualisation. The complexity of a concept varies from simple to complex, in terms of how many other concepts are subsumed by a given concept. The sophistication of concept depends on the degree of its refinement for learning purposes. It varies from descriptive level, through comparative to quantitative level. The easiest concepts to learn are simple, concrete and descriptive while the most difficult concepts to learn are complex, abstract and quantitative (Abimbola, 2013).

iii *Misunderstood Word*: A misunderstood word is a word, which is not understood, or a word that is wrongly understood. A misunderstood word will remain misunderstood until one clears the meaning of the word. Once the word is fully understood by the person, it is said to be cleared. The procedures used to locate and clear up words the student has misunderstood in any studies are called Word Clearing. The first thing to learn is the exact procedure to clear any word or symbol one comes across in reading or studying that is not understood.

To remedy misunderstood words encountered by learners who are exhibiting the preceding reactions, the instructor assists them to clear the words or they themselves clear the words using dictionaries. Abimbola (2013). This makes all these strategies applicable to how study technology could be used in STEAM. Reactions as a result of misunderstood word are illustrated with Figure 4. When the exhibited reactions are identified during instruction, then remedies should be provided and other process should be continued till full mastery.

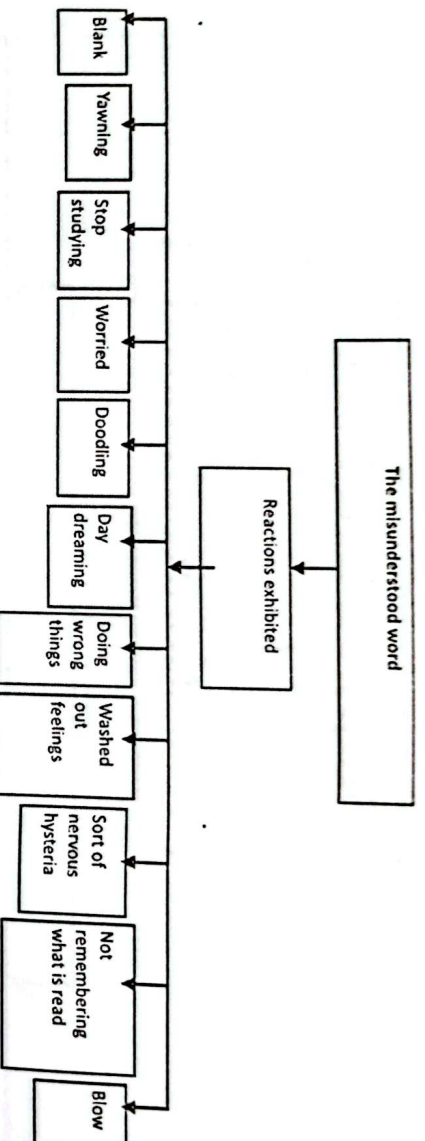


Figure 4: Physical and Mental Reactions Exhibited as a Result of Misunderstood Word.

Implications of Study Technology for Teacher Education.

- It is one of the strategies that could be adopted to shift from Teacher Centered Approach to Student-Centered Approach.
- Collaborative learning is enhanced due to “Twinning” (partner) Nature of Study Technology. This is possible because of the competition with self and with other twin partner during instruction. This communication between partners enhances intellectual development.
- Learners can discover their barriers to study and remedy them on their own (self-initiated learning); not only this, teachers, lecturers and instructors at all levels of education can prepare their lesson plans, and even course materials for e-teaching and e-learning using appropriate principles and methodologies of Study Technology.
- Course Materials for STEAM could be improved upon when structured and coded in order to avoid skipped a gradient and enhance flexibility of teaching and learning.

Conclusion

Promoting STEAM with Study Technology could be relatively new in Nigeria, especially on how students could be assisted with learning how to learn. Therefore, promoting STEAM Education in students and teachers with the knowledge of Barriers to study would solve the problems faced in all disciplines in STEAM.

In order to have a meaningful understanding of STEAM, the knowledge of Barriers to study could be one of the requirements. This will enhance effective delivery of instructions on the part of the teachers/lecturers as well as to solve Problem Skills in learners.

Recommendations

- Instructional materials required in Study Technology lessons are not expensive, therefore, both students and teachers across all STEAM disciplines should use it frequently
- Workshops and seminars on Study technology should be organized for teachers and students.
- School Principals and proprietors of school should support teachers using Study Technology by providing the enabling environment.

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