



Professional Development of Science, Technology and Mathematics Education (Stme) Teachers in Nigeria and the Use of Computer Assisted Instruction (CAI) for Teaching Mathematics

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Abstract

Science, Technology and Mathematics Education (STME) is an embodiment of technically related yet distinctive disciplines that humanity cannot do without. Mathematics a pivotal part of STME is viewed by many as an abstract subject, making the instructional strategies adopted by practitioners of the subject and the standard of teachers a matter of academic discourse. In focusing on the best possible approach to a professional mathematics content delivery, this paper draws a nexus between the use of Computer Assisted Instruction (CAI) a computerized instruction programme designed to instruct learners while interacting with them and the professionalism of the mathematics teachers. The paper further analyses the extent to which certain factors in the teaching of mathematics by professional teachers could influence the use CAI in mathematics classroom delivery. The paper recommended amongst others that professional development training and workshops for STME teachers be prioritized in computer-assisted method to boost efficient lesson delivery.

Keywords: Science, Technology, Mathematics Education (STME), Computer Assisted Instruction (CAI), Instructional strategies, Professionalism

Introduction

The level of growth of any nation depends on the level of educational awareness of its citizens which is reflected in their academic performance in school subjects. This according to Loughran (2014) rest on teachers' education and the selection, proper usage of appropriate and most effective methods necessary in the execution of a lesson content. Thus, teaching methods determine whether a teacher is communicating with his students or not (Bena, 2013).

The effectiveness of teaching is seen when the methodology applied in delivering the lesson brings about the desired behavioural change in the learner (Esuong, Uwem & Ofonime, 2019). Introducing learners to approaches of teaching that are suitable, effective and efficient will improve students' achievements and how they learn (Jack, 2013). Thus, focus on the teacher are on the increase regarding their personality, capabilities and professional development (Lunenberg et al., 2017).

Professional development (PD) is a medium that consistently educates teachers on the changes in their practices when new national educational policies arises, new innovations or new standards are implemented (Maria et al., 2022) and according to Abdul (2018), Professional Development will achieve its desired objectives in an environment where educational stakeholders, administrators and teachers showcases resilience, adherence and commitment to improve upon current practices hence enhancing the quality and productivity of education. The introduction of computers to education were not just meant to improve teaching quality but also for the professional development of teachers as well. Various applications such as Computer Assisted Instruction (CAI), Computer Managed Instruction (CMI), and Computer Based Instruction (CBI), among others made computer a useful tool in the teaching profession.

Introducing Information and Communication Technology (ICT) tools as



replacement to the traditional classroom is changing the learning behaviour of students. Hence, for a qualitative, quantitative and impactful lesson delivery and to prepare the present day learner fit enough to tackle complex problems that will arise in the future due to vast innovations and changes in the world of Science, Technology and Mathematics Education, teachers of STME subjects must be intentional, consistent and committed to the professional development and re-training in their areas of specialties as well as in the usage of ICT in facilitating learning.

The proper usage and effective application of Computer Assisted Instruction (CAI) would aid effective teaching and learning, driving away Mathematics phobia among learners. This, notion is supported by Bena (2013), when in his analysis concluded among other things that supplementing CAI to conventional method of teaching will produce desirable achievement than using only the conventional teaching method.

The importance and benefits of Mathematics as a school subject in Nigeria cannot be overemphasis. Educators are of the believe that Mathematics helps in the development of creative ability of the learner (Abasi and Ado, 2021) and that no individual can progress in any field of endeavour (Visser et.al.,2015) nor survive (Chand et. al.,2021) without the foundational knowledge of Mathematics.

Due to the various challenges encountered during their learning of the subject Pilli and Aksu (2013) asserted that people see mathematics from an absolutist point of view. Research has shown that the challenges facing Mathematics Education raises the inevitable question of teacher training, teaching strategies and the resources at teachers' disposal to improve their practices.

Since Mathematics Education plays a vital role in the development of Nigerian, this paper however, seeks to navigate the nexus that exist in the application of the novel Computer Assisted Instruction in the professional development of STME teachers with aim of getting teachers of Mathematics acquainted and well equipped with adequate and up-to-date skills, knowledge, and didactics for teaching the subject through the use of Computer Assisted Instruction (CAI).

Concept of Science, Technology, Mathematics Education (STME)

Science, Technology and Mathematics Education (STME) is a curriculum made up of technically related yet distinctive and discrete disciplines that humanity cannot do without as far as human development and national growth is concerned. It is an integrative approach to learning (Benson, 2017), used in the context of education policy in schools. STME plays a leading role in a nation's development and its importance is far reaching, reasons why many nations Nigeria inclusive are craving for its advancement (Mgbomo, 2013).

Furthermore, Science is a systematic and well organised knowledge of how the universe works. Technology in the other hand is the application of ideas, acquired skills, experiences, philosophy and resources to meet needs (Akpojedje & Abu, 2016).

Due to the intricacies and high abstract mental processes involved in the qualitative delivery of STME, Balasa et al. (2013) suggested that STME curriculum can only be properly delivered if strictly professionally trained STME teachers are made to handle STME teaching. This can be achieved by proper streamlining of the teaching sector and equipping the selected few with the ideals of proper delivery which may also entail production and supply of relevant teaching skills like the use CAI to improved conditions of teaching and learning of STME subjects. These however is lacking within the science sphere and this paper seek to address areas of exploitation for proper implementation.

Teachers Professionalism in Nigeria

Teaching as a profession is an activity consisting of actions intended to instigate learning process via responsive and purposeful effort of an expert to convey the needed ideas, information, skills, attitudes and beliefs to a less experienced individual (Fareo, 2015). It is a specialized application of knowledge, skills and attributes designed to provide unique services to meet educational needs of the individuals and of the society (Esuong et al., 2019).

The teacher decodes, explicates, and enforce the curriculum in the classroom. Acting as the middleman between the learner, aims and objectives of the curriculum and the learning



environment. The teacher does not only ensure a qualitative selection of both the teaching materials and teaching approaches suitable for the class, he also prepares and presents the content to learners, motivating, re-enforcing, evaluating and giving prompt feedback were necessary. As opined by Onah et al. (2020), “a learner's academic achievement depends mostly on the teaching strategies of the teacher”. Thus, the professional development of teachers must be given priority.

As enshrined in the National Policy in Education (FRN, 2013), registered teachers in Nigeria have been classified into four categories taking the academic qualification into consideration. These categories are:

1. Doctoral Teachers: Holders of Ph.D in Education or in other field with additional teaching qualification e.g. Post Graduate Diploma in Education (PGDE); Professional Diploma in Education (PDE); Nigeria Certificate in Education (NCE).
2. Masters Teachers: Holders of M.Ed in Education or in other fields plus teaching qualification e.g Post Graduate Diploma in Education (PGDE); Professional Diploma in Education (PDE); Nigeria Certificate in Education (NCE).
3. Graduate Teachers: Holders of bachelor's degree in education or in any other Field plus a teaching qualification e.g. PGDE, PDE, NCE.
4. NCE Teachers: Holders of the Nigeria certificate in Education which is the minimum qualification for teaching.

In Nigeria, teaching profession which is often believed to birth all other professions has passed through many phases. According to Fareo (2015) it has been a debating issue if teaching is actually a profession and this has raised concerns among educationist, teachers, school administrators, stakeholders in Education and the public. The obvious reason for this debate is because in Nigeria, quacks, half-baked and unprofessional teachers have infiltrated the system. Yusuf et al (2014) in their findings proposed that individuals who sees teaching as a part-time job that permits them to engage simultaneously in other profit-making businesses are not fit to be called teachers. Secondly, Fareo (2015) summarized the benchmark for a profession to be recognized as follows:

1. Performing vital Community Services.

2. Having a body of Specialized expertise.
3. Possessing higher level of Sovereignty.
4. A Code of Philosophy.
5. Organization into Professional Groups.
6. Putting Service over individual benefits.
7. Public Acceptance.
8. Putting up Standards.

The review has shown a serious practical gap in the area of professional enlistment of teaching practitioners. Regardless of the above listed level and academic qualifications, classrooms have been flooded with those who do not meet the least entry qualification to man the classroom thereby creating a situation where professional growth and development becomes thwarted and the impact of this disorganization is felt in the output of students. This brings an urgent need for the identified criteria for teaching profession to be implemented.

Computer Assisted Instruction (CAI)

Using the Computer for the sole aim of teaching and learning gives the learner the power to direct and restrain the lesson, intensify the passion to learn, links the learner to the real world and further improves the academic achievements of the learner during assessment test (Christensen, 2016). However, according to Sun (2021), the advancement of ICT has brought about crucial innovations in the teaching methods used by the teachers in the classroom, overcomes the limitations and setbacks of these methods as well as improves the Teacher-learner and learner-learner communication link. Kane as cited in Uzoechi (2013) opines that one of the major objectives for the usage of computer in education is to assist in the teaching and learning of traditional subjects such as Mathematics, English, History, etc. and that the computer software program that falls under this category are always referred to as Computer Assisted Instruction.

What then is CAI? Different researchers have given various definitions on the concept of CAI. Nwoji in Bena (2013) Opines that “CAI is an area in education that involves teaching technique in which a learner interacts with a computer system”. Nwosu as cited in Mezieobi et al. (2019), sees “Computer Assisted Aided Instruction as a computerized instructive teaching approach by which the computer presents programmed instructions to learners via the process of interaction”. Asides presenting the materials or



problem situations, CAI also guides the way the learner thinks, respond to learner's questions, assess the performance of the learner, monitor the progress of the learner in a particular course by selecting modules to be presented and tasks to be performed. Ukaigwe (2022), stipulates that CAI is using the computer by the learner to perform activities such as simulations, drill-and-practice or tutorial which is posed by the computer or as supplements to the conventional instructions by the teacher.

For this study, CAI is a carefully planned electronic education which is either online or offline whereby the computer acts on the already programmed modules keyed in by the teacher/Instructor to interact and convey the necessary knowledge and skills embedded in the modules to the learner in a more convenient and friendly way in the absence of the teacher/instructor.

According to Uzoechi (2013), "CAI falls into two categories namely (a) Tutor- The lesson to be taught is embedded in the computer and the learning environment is controlled by the computer, replacing humans in performance of tasks. (b) Tool- here, the computer is an assistance to the teacher". Recent studies have shown the characteristics of CAI to include:

1. Practice: CAI builds competency in the learner by encouraging and enabling repeated practices of a given task. CAI creates a supporting environment for all types of learners in the classroom.
2. Prompt feedback: Unlike the conventional method of teaching where the learner waits until the teacher is done marking the homework before giving the correct answers to a given task, CAI supplies the learner with the correct answer immediately a particular question is answered. This helps the learner to do corrections where necessary.
3. Personal-Evaluation: Learners via CAI discover their strengths, work on their weakness before entering the next module. This boosts confidence.
4. Reinforcement: Learners get instantly rewarded after giving a correct answer. This reward spurs and motivates learning.
5. Instant Evaluation: At the end of each module learners are to answer questions from what they have learnt. This

encourages immediate assessment and appraisal.

According to Bena (2013), Uzoechi (2013) and Nazimuddin (2014), the types of Computer Aided Instructions (CAIs) are:

1. Tutorial Programme: Information is given in small segments accompanied by assessment questions. The computer analyses the learner's answers and gives immediate and appropriate feedback. In tutorial programming, the more the alternative packages embedded in the computer the more the chances of the learner adapting to the lesson.
2. Drill-And-Practice: Provides students with the opportunity to practice repeatedly the skills learnt from the previous lessons. It provides the necessary repetition to achieve the retention of the subject matter. The computer proceeds further to the next module or lesson when the learner has shown mastery of the previous lesson.
3. Discovery System: Is like a laboratory approach of learning. Here the learner solves the given problems via trial and error. When a learner discovers how to solve problems independently, complex problems will not be a big challenge.
4. Gaming Mode: This is both instructional and recreational especially to younger learners.
5. Simulation: In this mode, the learner is exposed to activities that are realistic and risk-free.
6. Problem Solving: This is the software that helps learners to develop skills and approaches in solving problems. In this procedure, the learner is asked to solve multiple questions and the computer will give them feedback based on the choices made by the learner. There is a need for the learner to be conversant with the usage of computer.
7. Inquiry: This is a software in which CAI responds to the learner's inquiries already stored in the system.
8. Interactive System: This links the computer with an overhead projector or video disc. It permits interaction between the user (teacher or student) and the programme and vice versa. The user can



interact with the programme by stopping the video, freezing the picture and playing back to the desired or selected section.

9. Logo System: This programme which is mostly used by young learners aids them to produce images and pictures via sets of instructions provided by the software.

Implications of CAI in Teaching Mathematics

It is among the goals of the Nigerian Government as it regards Education that teaching should be made practical, activity-based, experiential and IT-supported (FRN,2013). Educationist while investigating the effects of CAI on student's learning attitude and their academic performances towards a particular subject discovered a significant effect on their learning attitudes. CAI packages that are well planned, prepared and presented facilitate the academic progress of the learner since the learner's enthusiasm is raised when they participate actively in what they see on their computer screen or via multimedia projection. It is of great necessity that both the teacher and the students be conversant with ICT (Azare, 2019).

Teaching of Mathematics at all levels of education should be made practicable as possible starting from the elementary stage into the higher level of learning. This is due to the abstract and logical nature of the subject. A learner of mathematics is expected among other things to be a good thinker, vested with accuracy in decision-making and problem-solving.

According to Uzoechi (2013), the Implications of using CAI in teaching Mathematics include but not limited to the following;

1. CAI provides better presentation of data due to its use of colours and sophisticated calculative devices.
2. CAI 's characteristics of ability to assess students' performance, feedback and reinforcement strategies can address the grey areas in Mathematics instruction. He noted that feedback from a teacher can be bias and inaccurate, but CAI can provide feedback that is accurate and non-judgmental, irrespective of the character and nature of the student's response.
3. Mathematical ideas can be explained pictorially. These images will help the learner to understand the concept easily.

With the conventional teaching method, the learner may get easily discouraged while practicing repeated sum.

4. Retention of contents by the students is higher in CAI than the traditional approach as whatever is learnt via CAI lingers longer in the minds of the learners. With the help of CAI, learning is interesting and without difficulties.
5. Students' academic needs differs. While some are slow in learning, others are fast in learning and unlike traditional approach of teaching, CAI as a personalized instructor that caters for the learner's individual academic needs.
6. CAI gives the learner the personal learning experience and a free hand to select what will interest them to learn according to the learner's level of understanding. This one-to- one learning approach where the learner is occupied with activities from CAI will bring about class control especially in an overcrowded classroom, concentration and improvement in the academic performance of the learner in the classroom.
7. CAI makes learning interesting, engaging and interactive by giving the learners multiple examples and diagrams with prompt feedback to the learner's performance.

This paper, practically align teaching professional development and the use of CAI in effective classroom mathematics content delivery. The standard criteria as enshrined in the National policy in education for teachers' enlistment must be adhered strictly, it is upon this standard practice that the implementation of the novel CAI in classroom delivery can be attained.

Recommendations

1. Nigerian government and Education stakeholders in the country should make efforts to improve upon the teaching profession in the country by bringing policies that will favour the profession.
2. Professional development training and workshops for STME should be prioritized both in the computer-assisted method and traditional teaching method.
3. Enough computers and educational packages should be injected into STME



syllabuses as well as computer literacy for both the teacher and the learner should be encouraged.

4. The Government of Nigeria and the stakeholders of Education in the country should ensure that Mathematics textbooks are patterned and harmonized with relevant education and information computer technologies. This will facilitate the teaching and learning of mathematics.
5. Teachers of Mathematics at all levels of learning should devote themselves to the learning of CAI packages as provided in schools and other electronic medium.

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