

***The Use of ICT in Mathematics Classroom: Implications for National Mathematics  
Contents Development for Basic Education in Nigeria***

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**Abstract**

*This study reviews ICT and mathematics learning in Nigeria. Available literature shows that even if teachers believe that the use of ICT improves students' development, they do not incorporate ICT into Mathematics Classrooms or use it in traditional ways to impart knowledge. The effective use of ICT in Mathematics education may lead to more learners' classroom practices. These changes are widely believed to impact mathematics teaching and learning positively. For example ICT can enrich students' mathematics learning experience, increase their interest in mathematics and change their attitude towards mathematics. With the proliferation of online e-teaching, flipped classrooms, use of Matlab, Geogebra, simpsonmath, math pickle, SPSS and other mathematics apps, the application of these in the teaching/learning process of mathematics is becoming a new trend in digital learning. This paper is an exposition on some of these apps; the paper recommends, among others, that schools should send their mathematics teachers to workshops in order to update their knowledge on application of ICT in Mathematics classroom.*

**Keywords:** ICT, mathematics, classroom, content, development

**Introduction**

In Nigeria, mathematics is a compulsory subject at all levels in pre-university education. Due to its importance the government is committed to ensuring the provision of high-quality mathematics education. Various attempts have been made in the past to improve achievement in mathematics in schools. The new curriculum in Mathematics at the Senior Secondary School (SSS) places emphasis on skill acquisition, creativity and the arts of enquiry and problem solving. It aims at developing in the student the ability and willingness to perform investigations using various mathematical ideas and operations.

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Information and Communication Technology (ICT) is introduced as an effective tool for teaching and learning of mathematics. Following the trend in mathematics education, there are a lot of interesting web tools for teachers and students to use in mathematics classroom. Methods of teaching to achieve the desired instructional objectives in a lesson class have been a major concern over the years. This is so because if learners fail to acquire the desired competence, it means that the teachers have also failed in their task to deliver effective instructions to the learner whose primary reason of going to school is to acquire new skills and knowledge. If learners have not learnt, it therefore means that the teacher has not taught. Method adopted by the teacher can either make or mar the learner. The use of information and communication Technology (ICT) in mathematics classroom is therefore a unique step in this direction.

Integrating technology into the classroom has become essential to successful teaching and learning. Therefore, integrating information and communication technology (ICT) into education remains essential for teachers to teach effectively. Integrating ICT into teacher education and classroom practice is complex and challenging. In this regard, equipping schools with essential ICT tools alone will not improve the quality of education or create a more effective learning environment. As a result, the government attempted to improve mathematics performance in schools and implemented curriculum reforms focusing on ICT as a tool for teaching mathematics (Umar & Musa, 2022).

Adopting information and communication technology (ICT) has become an essential tool to support innovative education and improve the learning process of students. For example, Das (2014) believes using technology in mathematics classes with appropriate pedagogy will improve students' academic performance. Das (2014) have reiterated that deep conceptual learning can become a reality when mathematics is viewed as problem-solving and thoughtfully combined with technology. ICT learning environments enable students to become fluent in various expression systems, provide opportunities to create and modify forms of expression, develop skills to create and explore virtual environments, and help them understand the world. The National Council of Teachers of Education (NCTM) believes that technology is an essential tool for learning mathematics in the 21st century and that all schools are committed to helping all students harness the full potential of technology to advance their understanding.

It is very beneficial for teachers to use ICT to teach their students. This is because using ICT allows her to demonstrate her understanding of the possibilities and implications of ICT for learning and teaching in a curricular context. ICT integration can significantly impact a teacher's work, especially if her ICT is conceived as a tool to support changes in educational approaches. Teachers will need to change their roles and the organization of their classrooms, but they will also need to invest energy in themselves and their students, especially in preparing them to introduce and manage new learning arrangements. According to Ching (2016), ICT plays a unique but complementary role in each of these approaches, as new technologies require new teacher roles, new teaching methods, and new elements of teacher education.

ICT simulation and animation also served as a catalyst for turning abstract concept in Science and Mathematics to reality. This concept is based on the fact that when the

learners' interest towards a particular subject is developed, he will achieve more through self-involvement and constant practices. The success of ICT integration will depend on teachers' ability to combine technology with new teaching methods. To achieve this, teachers need adequate preparation, time, and ongoing support to ensure they have the knowledge, skills, and confidence to teach using ICT. The need to provide teacher training programmes and professional development facilities for current and future teachers cannot be over-emphasized (Reyes, 2019). Undoubtedly, the main challenges in integrating ICT into the classroom are its educational impact, its impact on curriculum structure and content, classroom organization and practice, and the changing role of teachers (Gipson, 2003).

Teachers should continue integrating these new technologies into their classrooms as the world revolves around technology. Teachers should continue incorporating these new technologies into their students' lessons to achieve efficiency and effectiveness (Foluke, 2017).

### **Information and Communication Technology**

Information and Communication Technology (ICT) has become one of the fundamental building blocks in modern society. First approved in the mid-1980s, and was defined as all kinds of electronic system used for broadcasting, telecommunication and mediated communication, with examples including personal computer, video games, cell phone, internet and electronic payment system and computer, among others. The term "Information and Communication Technology" (ICT) refers to forms of technology that are used to transmit, store, create, share or exchange information. This broad definition of ICT includes such technologies as radio, television, video, telephone (both fixed line and mobile phones), satellite systems, computer and network hardware and software, as well as the equipment and services associated with these technologies, such as video conferencing and electronic mail (Lahad et al., 2012). ICT in mathematics education involves teaching and learning with ICT. Research has shown that ICT can lead to improving students' learning and better teaching methods. In recent years, new technology and computer and internet have affected dramatically all aspects of the society. Many traditional activities have become obsolete, while new professions and new challenges arise. For instance, Technical drawing is no longer done by hand nowadays; instead, one uses commercial software, plotters and other technological devices.

In the present time, students are interested in learning Mathematics if teaching is done by using interactive methods and ICT tools. These methods help in better understanding of concepts, because it helps them to visualize mathematical problems. It helps students to understand practical meaning of mathematical tasks. In this paper, some tools of ICT for learning and teaching mathematics are discussed.

### **Basic Education in Nigeria**

The desire of the nations of the world to reduce illiteracy, combat ignorance and encourage access to education even to the grassroots necessitated Education for All (EFA) as stated in the Jomtien Declaration which was a treaty launched and signed in Jomtien, Thailand in March 1990 (Egbe & Eze, 2009). The mandate so placed on the Universal Primary Education (UPE) programme which was with the goal that by 2015, children

everywhere, boys and girls alike will be required to complete a full course of primary schooling, was mandatorily to go on and produce qualitative educational outcomes. But this goal of a qualitative universal education for the citizenry of Nigeria never really took root until the 1990 declaration of education for all because the programme within the period under consideration encountered so many difficulties that the government of the day was not really able to manage effectively and efficiently or even surmount. These pitfalls as enumerated included political instability, inconsistent policy formulation and implementation, and sustenance, lack of sincerity on the part of the programme implementers, unavailability of statistical records, uncoordinated planning and execution practices, low institutional capacity, poor technical competence, poor logistic support system and neglect of available teachers (Samuel & Victor, 2020).

The foregoing clearly is indicative of what could be described as a hill-valley state for the UPE programme and the arrangement of primary education particularly Education for All in Nigeria over those years because of instability appearing in all its forms and dimensions leading to disequilibrium in actualizing the intent of educating and producing citizens that would make useful contributions to the society (Benson, 2008). However, at the return of democratic government in Nigeria with President Olusegun Obasanjo again on the saddle of leadership in 1999, specifically in September and in Sokoto State, the Universal Basic Education (UBE) was launched still with the intention to pursue the treaty of Education for All (EFA).

According to Akor (2018), in the speech of Mr. President, he unequivocally stated that the educational system would be free and compulsory for every Nigerian child who is of school age and this bold declaration actually supports and agrees with the dictates of the National Policy on Education which is to achieve the goals of Education for All through the following objectives of the UBE programme:

- a) Develop permanent literacy and numeracy, and ability to communicate effectively.
- b) Lay a strong foundation base for scientific and reflective thinking.
- c) Give citizenship education as a ground for effective participation and contribution to social life.
- d) Mould character and bind sound attitude and morals in the child.
- e) Develop in the child the ability to adapt to the child's environment.
- f) Give the child opportunities for developing manipulative skills that will enable the child to function effectively in the society within the limits of the child's capacity.
- g) Provide the child with basic tools for further educational advancement including preparation for trades and crafts of the locality.

The major essence of the UBE programme from the stated objectives and possibly its effective and proper implementation of the intents is to ensure that each child is built up with marketable skills that would enhance self-employment as well as reduce the dependence on paper qualification (Fowowe et al., 2009).

### **Mathematics and ICT**

Students can use ICT as a tool to perform calculations, draw graphs and help solve problems by the use of a calculator or something like that to perform more challenging

computations. Spread sheets, computer algebra system or graphical calculators can also be used to solve problems by test and improvement or retrieval method; as such students of mathematics can use graphical calculators or graph plotters instead of algebra to graphically solve an equation. Students use ICT as a tool to help search things out, solve problems or understand what is going on, it often helps them develop their skills in the use and application of mathematics.

## **ICT tools for teaching and learning in Mathematics classroom**

### **A. Smart classrooms**

Smart classrooms are technologically enhanced classrooms that provide opportunities for learning and teaching using technology such as computers, specialized software, networking, audio/visual facilities, projector and screen and other educational technologies. They provide interactive environment where teachers can also link online resources with their lectures. It is a great tool of learning using pictures, maps, graphs, audios, videos, Power point presentations, 2D & 3D animations and so on. Flipped classroom is used to teach and learn using educational technologies which can replace the traditional classroom.

### **B. Social media**

Technology encourages learning with social media such as Whatsapp, Facebook, Instagram, E-mail and others. Whatsapp messenger allows its users to exchange text messages, images, audios and videos. These can be used as alternative classrooms where students and teachers can do group discussions. Here one can share their views and also can discuss problems and also get timely solution to problems. Each social media platform offers many different ways to be used in the classroom, from sharing announcements to holding live lectures, and so much more. Social media provides a smoother, more direct communication tool between students, teachers and parents, who can check in and ask or respond to questions. Social media allows for more e-learning opportunities in secondary schools.

### **C. Teacher tube**

TeacherTube is a video sharing website. It is designed to allow those in the educational industry, particularly teachers, to share educational resources such as video, audio, documents, photos, groups and blogs. The site contains a mixture of classroom teaching resources and others designed for teacher training. Mathematics teachers can learn from one another by watching videos posted on the site. Mathematics teachers can also set up videos for students' viewing in order for them to learn a certain concept or skill.

### **D. Websites**

There are millions of websites which are helpful in learning and teaching mathematics. These websites provide a platform for discussion among teachers and students on many issues that arise during general learning and teaching of mathematics. Many websites help teachers in planning their lectures while some of them present some wonderful methods to motivate learning mathematics through different games. Few of these websites are as follows: National Council of Teachers of Mathematics, Math Central, the Math Forum, Simpsonsmath, Math Pickle, Internet Archive, Mathematics Stack Exchange, Math Guide, Math Drills, Math Goodies, Absurd Math, Graph Maker, Mobile Apps like; Zoom, Telegram, Calculator, Geometry Pad, Maths Formulas, Maths Playground, and others.

### **Software use in Mathematics classroom**

The use of mathematical software in learning and teaching mathematics is increasing. Some of the software are very expensive and beyond the reach of students and teachers individually. Some of these software are freeware and some are proprietary software. Freeware software are those software that give the end-user ultimate control over the software (Stallman, 1983), while proprietary software deny its end-user ultimate control (Saraswati, 2017). The freeware can easily be shared while proprietary software cannot be shared easily without permission from the developers. Most of the software used in Mathematics classroom is freeware because after paying for the package the end-user have ultimate control over the package while some are not. MATLAB and GeoGebra are proprietary software while SPSS are freeware software.

#### **1) MATLAB**

MATLAB is a proprietary software. MATLAB can be used as a tool for simulating various electrical networks but the recent developments in MATLAB make it a very competitive tool for Artificial Intelligence, Robotics, Image processing, Wireless communication, Machine learning, Data analytics and others. Though it is mostly used by circuit and mechanical branches in the engineering domain to solve a basic set of problems, its application is vast. It is a tool that enables computation, programming and graphically visualizing the results. The basic data element of MATLAB as the name suggests is the Matrix manipulation. MATLAB toolboxes are professionally built and enable users to turn their imaginations into reality. MATLAB programming is quite similar to C programming and just requires a little brush up of basic programming skills to start working with. Its application include: mapping, deep learning, financial analysis, text analysis and image processing.

#### **2) Statistical Package for the Social Sciences (SPSS)**

SPSS Statistics is a statistical software suite developed by IBM for data management, advanced analytics, multivariate analysis, business intelligence, and criminal investigation. Long produced by SPSS Inc., it was acquired by IBM in 2009. Current versions have the brand name: IBM SPSS Statistics. The software name originally stood for Statistical Package for the Social Sciences (SPSS), reflecting the original market, then later changed to Statistical Product and Service Solutions.

SPSS is a widely used programme for statistical analysis in social sciences. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners, and others. The original SPSS manual (Nie et al., 1970) has been described as one of "sociology's most influential books" for allowing ordinary researchers to do their own statistical analysis. In addition to statistical analysis, data management (case selection, file reshaping, creating derived data) and data documentation (a metadata dictionary is stored in the data file) are features of the base software.

#### **3) GeoGebra**

Geogebra (a portmanteau of geometry and algebra) is an interactive geometry, algebra, statistics and calculus application, intended for learning and teaching mathematics and science from primary school to university level. GeoGebra is available on multiple platforms, with apps for desktops (Windows, macOS and Linux), tablets (Android, iPad and Windows) and web. GeoGebra is an interactive mathematics software suite for learning and teaching science, technology, engineering, and mathematics from primary

school up to the university level. Constructions can be made with points, vectors, segments, lines, polygons, conic sections, inequalities, implicit polynomials and functions, all of which can be edited dynamically later. Elements can be entered and modified using mouse and touch controls, or through an input bar.

### **Challenges in using ICT in teaching and learning in mathematics classroom**

Integrating ICT into teaching and learning is a complex process and one that may encounter a number of difficulties. The following are some of the key challenges that have been identified in teachers' use of ICT tools in classrooms:

i) Limited accessibility and network connection: Lack of access to resources, including home access, is another complex challenge that prevents teachers from integrating new technologies into education.

ii) School with limited technical support: Without both good technical supports in the classroom and whole-school resources, teachers cannot be expected to overcome the obstacles preventing them from using ICT. In the view of primary and secondary school teachers, one of the top barriers to ICT use in education was lack of technical assistance.

iii) Lack of effective training: The challenge most frequently encountered is inadequacy in ICT training and use of ICT gadget and finding of opportunities for teachers in using ICTs in a classroom environment.

iv) Poor internet connectivity mostly in rural area: Rural areas have difficulty to reach out to internet connectivity or inadequate internet resources.

v) Inadequate power supply in rural areas: ICT gadgets are mostly electronic devices and need electricity to power it; and rural areas are faced with inadequacy of power supply.

### **Benefits of ICT in Mathematics classroom**

ICT is very relevant in the Mathematics classroom as ICT gadgets and resources aids in the effective teaching and learning of mathematics in secondary schools. Some of these benefits include:

1. Assist students and teachers in accessing digital information efficiently and effectively: ICT gadgets helps the students to access digital information in the internet and this aids in information collection in the classroom.

2. Support self-centred and self-directed learning: students can always learn independently with the use of computers. Such learning strategy gives the learners opportunity to learn at their own pace, reviewing what was taught in the class over and over again till he/she gain mastery (Holland & Muilenburg, 2011).

3. Produce a creative learning environment: Flipped classroom gives the learners a learning environment that is child-friendly; also the use of ICT gives room for creativity. Promote collaborative learning in a distant learning situation: ICT gives room for distant learning and open-education programme.

4. Offer more opportunities to advance critical (Higher order) thinking skill: ICT gives room for exploration of more information on a subject matter and leads to advance critical thinking.

### **Implications of ICT for National mathematic contents development in Nigeria**

Content development is the process of creating a piece of content through researching, writing, gathering information, info-graphics, audio and video material. Mathematics

contents developments is the process of creating a piece of contents on mathematics for the purpose of knowledge dissemination. Mathematics Association of Nigeria (MAN) had been responsible for creating and developing relevant knowledge content in mathematics through curriculum development, publishing mathematics textbook and also organising conferences and workshops for mathematics teachers to educate and equip them about the pedagogy of mathematics education.

Adopting information and communication technology (ICT) has become an essential tool to support innovative education and improve the on-going learning process of students. For example, Das (2014) believes using technology in mathematics classes with appropriate pedagogy will improve students' academic performance. ICT is very relevant in national content development in Mathematics as it aids the contents developers to gather relevant information that will contribute to contents development. The content developer uses ICT to gather relevant information about Mathematical concept; also with the use of ICT, they can reach-out to their targeted end-users.

ICT is thought to affect mathematics education positively, but in practice, teachers may not use it at all or use it in a very traditional way. A teacher's attitudes and beliefs about the use of ICT are cited as significant obstacles to a teacher's practical adoption and effective use of ICT (Eickelmann & Vennemann, 2012). More importantly, effective ICT integration makes mathematics (such as abstract concepts) more accessible to students, enhances students' understanding of mathematical concepts, enhances students' problem-solving skills, and improves higher levels of students' mathematical thinking and math performance in general (Prestridge, 2012).

### **Conclusion**

ICT can change the role of students and teachers in the process of learning and teaching mathematics. The effective use of ICT in Mathematics education may lead to more learners' centred classroom practices. These changes are widely believed to impact mathematics teaching and learning positively. For example ICT can enrich students' mathematics learning experience, increase their interest in mathematics and change their attitude towards mathematics. With the proliferation of online e-teaching, flipped classrooms, use of Matlab, Geogebra, simpsonmath, math pickle, SPSS and other mathematics apps are becoming a new trend in digital learning. By proper implementation of ICT, the whole system of learning can be changed. One should make efforts to change the process of learning and teaching in order to prepare the students to adjust themselves and contribute to the prosperity and well-being of the nation. This leads to the creation of a new learning environment for betterment of the future of the nation.

### **Recommendations**

1. Schools should sponsor their mathematics teachers to workshops in order to update their knowledge on application of ICT in the teaching of mathematics.
2. Provision of adequate learning facilities and a conducive learning atmosphere are necessary for effective learning and retention of what is learnt.
3. For improving the teaching learning process and academic achievement of Mathematics students, the use of ICT in Mathematics classroom need to be promoted in the school.



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