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Influence of Information and Communication Technology on the Teaching and Learning of Mathematics in Oyo West Local Government Area

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Abstract

Information and Communication Technology in Education is vital in the 21st-century classroom, enabling digital literacy, flexible learning and access to a wealth of online educational resources. This study investigate the influence of Information and Communication Technology ICT in teaching and learning of Mathematics in secondary school in Oyo West Local Government Area, Oyo, Oyo State. Two different questionnaire was employed 1 for the Teachers and 1 for the Students to a sample 110, 10 Teachers and 100 Students from 5 secondary schools in Oyo West Local Government Area, Oyo, Oyo State. The instrument was validated by the two experts. Hypothesis were tested at 0.05 level of significant. Chi-square statistic was used to analyze the data collected. The results shows a significant positive correlation between the influence of Information and Communication Technology ICT in teaching of Mathematics and influence of Information and Communication Technology ICT in learning of Mathematics. There is a significant relationship on ICT usage and students' understanding of Mathematics concept and Mathematics teaching methods in secondary schools within Oyo West Local Government Area, Oyo, Oyo State. There is a significant relationship on possibly teachers' related factors and ICT integration challenges in secondary schools within Oyo West Local Government Area, Oyo, Oyo State. The study concludes that teaching and learning of Mathematics is influenced by Information and Communication Technology. The study recommend that effective integration of ICT in the teaching and learning of Mathematics requires adequate infrastructure
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Keyword: Information and Communication Technology (ICT), Teaching, Learning, Mathematics

Introduction

In recent years, the integration of Information and Communication Technology (ICT) into education has transformed the way teaching and learning take place. In the field of Mathematics, ICT has introduced innovative tools and resources that help teachers explain abstract concepts and help students understand complex ideas more easily. From calculators and computers to interactive whiteboards and math software, ICT plays a vital role in modern classrooms. As educational systems around the world adopt digital methods, it becomes essential to study how these technologies impact Mathematics teaching and learning.

ICT stands for Information and Communication Technology. It is the combination of two terms, i.e., Information Technology and Communication Technology. ICT has fundamentally shifted teaching and learning from passive knowledge transfer to active, student-centered experiences. While it offers unprecedented opportunities for personalization, collaboration, and skill development, its success hinges on equitable access, teacher training, and critical pedagogical integration (Kaplar, Novak & Kolar-Begovic, 2021).

Adebayo & Alabi (2021), ICT in education includes tools like computers, the internet, projectors, and educational software that support instructional delivery and learning outcomes. Oyelami et al. (2023) emphasize that ICT is not just about hardware but also the ability to use digital resources effectively to communicate, collaborate, and solve problems. Iroegbu & Okonkwo (2020) defines ICT as technologies used for gathering, processing, and sharing information, especially through digital means, which have become essential in modern education systems.

Adebayo & Alabi, (2021) Seen ICT as a broad term that includes all technologies used for gathering, storing, retrieving, processing, and transmitting information, particularly within educational systems to enhance teaching and learning. ICT encompasses computer-based tools and applications that support communication, content creation, access to educational materials, and delivery of instruction. ICT includes radio, television, computers, mobile phones, and internet-based platforms used to enhance teaching, learning, and educational management. ICT in education fosters interactive learning environments and supports student engagement, especially through digital simulations, multimedia tools, and collaborative platforms. (Yusuf & Balogun, 2024). ICT is vital in the 21st-century classroom, enabling digital literacy, flexible learning, and

access to a wealth of online educational resources. ICT serves as both a teaching aid and a learning resource, helping teachers deliver content more effectively and students to learn at their own pace. Mathematics is the study of numbers, shapes, and patterns, using logical reasoning and quantitative calculation to explore relationships and structures. It involves the study of quantity, structure, space, and change, and is applied in various fields like science, engineering, and economics. Mathematics is fundamentally the science of structure, order, and relation, derived from the logical manipulation of symbols. It is a vast discipline encompassing the study of quantity (arithmetic, algebra), structure (algebra, topology), space (geometry), and change (calculus, analysis) (Brown, 2020). Mathematics serves as the universal language for describing and modeling the physical and abstract world. Its concepts provide the essential tools for nearly every other scientific and engineering discipline from physics and finance to computer science and biology (Azzouni, 2021). Ernest (2021) argues that Mathematics is "a social construction emerging from human activities, shaped by historical contexts and cultural values." This view challenges the traditional Platonic notion of Mathematics as discovered truth, instead positioning it as invented knowledge. Barwell (2021) characterizes Mathematics as "a specialized form of language that enables precise communication about quantities, structures, and relationships across disciplines." This dual nature allows Mathematics to bridge theoretical abstraction and practical application. Schoenfeld (2022) describes mathematical thinking as "a set of cognitive practices including problem-solving, pattern recognition, and the construction of logical arguments that extend beyond numerical computation." Mathematics is the science of logical reasoning, problem-solving, and abstract thinking that supports innovation and technological advancement in society. (Olaniyi, 2023).

ICT is changing processes of Mathematics teaching and learning by adding elements of vitality to classroom education environments, including virtual environments for the purpose. The new digital ICT is not a single technology; it is a combination of hardware, software, multimedia, and delivery systems. Today, ICT in education encompasses a vast range of rapidly evolving technologies such as desktop, notebooks, and handheld computers, digital cameras, the internet, cloud computing, the world wide web, spread sheets, tutorials, simulations, email, local area networking, bluetooth, streaming, and DVDs; and applications such as word processors, virtual environment, simulator, digital libraries, computer-mediated conferencing, videoconferencing, Emulator etc. ICT allows to produce digital resources such as digital libraries, where students,

teachers, and professionals can access study material and course material from anywhere at any time.

Students can smoothly perform a statistical analysis of the data they collect using the extensive statistical features of the graphical calculator. Creating an image in a dynamic geometry package can help a student understand, solve, and then prove a geometric problem. When students use ICT as a tool to help them search things out, solve problems, or understand what's going on, it often helps them develop their skills in the use and application of Mathematics. ICT can be an extensive and efficient tool, but students need to learn the technical skills they need if they are to use the opportunities provided.

Effective teaching and learning are preserved by focusing on cognitive tasks and activities and focusing on students' emotions, feelings, and enthusiasm or humanizing students. So, whenever students' feelings are considered, learning becomes motivational and leads to the student's success. ICT in education helps in developing critical and scientific thinking among the students and the teachers. It motivates the learner to participate in learning activities at any time and from anywhere. It helps in exchange and shares ideas among teachers for professional growth. ICT is also used to improve access and the quality of teacher training. ICT tools enhance teaching, and facilitate learning using multimodal courseware, Integrate ICT using pedagogical innovations to develop higher-order thinking skills among learners.

ICT is an integral part of how we work and live. Integrating ICT into classrooms teaching and learning will better prepare students to use ICT to learn, research, collaborate and solve problems from an early age. ICT furnishes visual images of mathematical ideas, facilitates organizing and analyzing data, ICT computes efficiently and accurately, engaging students and creating active learning. Thus, teaching and learning of Mathematics can be influenced by the use of Information and Communication Technology (ICT). By conducting a study in Oyo West Local Government Area, to gain insight into the Influence of Information and Communication Technology (ICT) in teaching and learning of Mathematics.

Statement of the Problem

This study seeks to investigate how ICT influences the teaching and learning of Mathematics and to identify the barriers preventing its effective use. Despite the recognized benefits of ICT in education, many Mathematics teachers and students still face challenges in effectively using these tools, so teachers try to avoid using ICT. Therefore, timely assurances of technical support can

help teachers provide appropriate lessons and provide lessons. Technical constraints include Internet connection failure and ICT equipment malfunction.

Inadequate provision of ICT tools, most of the schools have few ICT facilities such as Computer, projectors, laptops, mathematical software, and very few schools that have ICT facilities are not using them for teaching Mathematics. Whereas there should be adequate provisions of ICT tools in each school, while will facilitate the teaching and learning process, schools with ICT facilities ought to use the available tools for teaching and learning of Mathematics. In some cases, teachers argued that the fear of breaking the ICT equipment, teacher cannot locate and run an application program, connect computer and its peripherals, access information on CD/DVD, use spreadsheets package very well, access internet sites via its website address, download file from internet, send or receive e-mails messages, communicate online with other Mathematics teacher to share ideas.

Lack of adequate opportunities for teachers to receive ICT based training, teachers do not have the kind of knowledge needed to teach Mathematics with technology, lack of effective training on the use of ICT in Mathematics classrooms is most frequent barrier. Sufficient time for the teachers to train in the subjects related to the practice. ICT and basic ICT training require curricular training about the curriculum. Johns, providing educational training to teachers is more important than simple training for teachers about the use of ICT equipment.

Limited access to technology and insufficient support often hinder the full integration of ICT in classrooms. Students and teachers access to hardware, software and online technologies is low in Nigeria schools. Good access to ICT use is clearly related to frequent use of ICT for Mathematics teaching. Lack of access to ICT tools including home access is a barrier that discourages teachers from integrating ICT into Mathematics classrooms.

Purpose of the Study

The main purpose of this study is to investigate the influence of Information and Communication Technology (ICT) in teaching and learning Mathematics in Oyo West Local Government Oyo, Oyo State. Specifically, it sought to if;

1. ICT has influence on teaching Mathematics in secondary schools in Oyo West Local Government Area, Oyo, Oyo State
2. ICT has impact on students understanding of Mathematics concept in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

3. there is a relationship on the challenges faced by teachers and teachers in integrating ICT into Mathematics instructions in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.
4. There is a relationship on how teachers and students manage the challenges faced in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

Hypotheses

This following hypotheses were tested at 0.05 level of significant:

$H_0$1: ICT has no significant influence on teaching Mathematics in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

$H_0$2 . There is no significant on the impact ICT have on students understanding of Mathematics concept in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

$H_0$3: There is no significant relationship on the challenges faced by teachers and students in integrating ICT into Mathematics instructions in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

$H_0$4: There is no significant relationship on how teachers and students manage the challenges that is being faced in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

Methodology

This study used a descriptive survey design to explore the influence of ICT on teaching and learning Mathematics. This method allows for gathering detailed information from teachers and students about their experiences and challenges with ICT. The target population for this study are Mathematics teachers and students from secondary schools in Oyo West Local Government Area, Oyo, Oyo State. The study make use of Slovin in selecting sample from the population focusing specifically on teachers and students in Oyo West Local Government Area, Oyo, Oyo State. The population size consist of Eleven (11) secondary schools, Five (5) schools was selected and a sample of two (2) teachers and twenty (20) students make one hundred and then (110) samples was selected using simple random samplings from each school to ensure fairness and representativeness.

The instrument that will be adopted for this study is a self-designed questionnaire on the influence of Information and Communication Technology (ICT) in teaching and learning of Mathematics in secondary schools. The questionnaire consists of two sections. Section A will elicit response personal data of the respondent showing their age, gender, ... Section B will contain (20) twenty

statements on the influence of Information and Communication Technology (ICT) in teaching and learning of Mathematics in secondary schools. The respondent will be asked to respond to the questions on four linkers scale of Strongly Agreed (SA), Agreed (A), Disagreed (D), Strongly Disagreed (SD). The research instrument will be given to experts for content validation. Necessary corrections will be made by the supervisor to ensure the validity of the instrument before being administered. The reliability of the instrument was tested using the test-retest method, the questionnaire was first administered to 10 students and 1 teacher outside the main sample population, and re-administered two weeks later. The responses from the two administrations were done using PPMC. A reliability coefficient of 0.82 was obtained, indicating a high level of consistency and dependability of the instrument. The researchers will seek permission from the Heads of Schools before the questionnaire were administered. The researchers personally administered the questionnaire to the participants in order to avoid indefinite responses which might have effect on the result analysis. Data collected from the respondents through the structured questionnaire was analyzed using Chi-square to test the hypotheses at 0.05 level of significance.

Results

$H_0$1: ICT has a significant influence on teaching Mathematics in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

Table 1: Decision Table

Variables	Frequency	df	X^2 - cal	X^2 - crit	Decision
SA A D SD	27 23 0 0	12	0.48	21.03	Accepted

Level of Significant = 0.05, Calculated X^2 = 0.48, Tabulated X^2 = 21.03

Decision: since X^2 cal < X^2 tab (0.48 < 21.03) therefore the null hypothesis is accepted. There is a significant relationship on ICT usage and Mathematics teaching methods, ICT likely play roles in shaping teaching practice in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

$H_0$2 . There is a significant on the impact ICT have on students understanding of Mathematics concept in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

Table 2: Decision Table

Variables	Frequency	df	X^2 - cal	X^2 - crit	Decision
SA	15				
A	33	12	10.54	21.03	
D	1				Accepted
SD	1				

Level of Significant = 0.05, Calculated X^2 = 10.54, Tabulated X^2 = 21.03

Decision: since X^2 cal < X^2 tab (10.54 < 21.03) therefore the null hypothesis is accepted. There is a significant relationship on ICT usage and students' understanding of Mathematics concept in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

$H_0$3: There is no significant relationship on the challenges faced by teachers and students in integrating ICT into Mathematics instructions in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

Table 3: Decision Table

Variables	Frequency	Df	X^2 - cal	X^2 - crit	Decision
SA	15				
A	29	12	3.8	21.03	Accepted
D	6				
SA	0				

Level of Significant = 0.05, Calculated X^2 = 3.8, Tabulated X^2 = 21.03

Decision: since X^2 cal < X^2 tab (3.8 < 21.03) therefore the null hypothesis is accepted. There is a significant relationship on possibly teachers' related factors and ICT integration challenges in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

$H_0$4: There is no significant relationship on how teachers and students manage the challenges that is being faced in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

Table 4: Decision Table

Variables	Frequency	df	X^2 - cal	X^2 - crit	Decision
SA	28				
A	20	12	4.56	21.03	Accepted
D	2				
SD	0				

Level of Significant = 0.05, Calculated X^2 = 4.56, Tabulated X^2 = 21.03

Decision: since X^2 cal < X^2 tab (4.56 < 21.03) therefore the null hypothesis is accepted. There is a significant relationship on how we manage the challenges that is being faced in secondary schools in Oyo West Local Government Area, Oyo, Oyo State.

Discussions of Findings

The study that there are significant relationship on the influence of Information and Communication Technology (ICT) in teaching and learning of Mathematics in secondary Oyo West Local Government Area, Oyo, Oyo State.

Most respondents agreed that the use of ICT tools like interactive whiteboards, projectors, and educational software enhances the delivery of Mathematics lessons by making concepts clearer and more engaging. The study found that teachers who use ICT tools like GeoGebra, Desmos, and projectors report better delivery of Mathematics lessons. ICT makes abstract topics more concrete and allows teachers to demonstrate real-time visualizations (Yusuf & Onasanya, 2021).

The integration of ICT was found to significantly improve students' understanding of mathematical concepts, resulting in better academic performance and increased interest in Mathematics. Students exposed to ICT-based instruction showed improved comprehension, problem-solving, and retention of mathematical concepts. Visual and interactive tools supported different learning styles, increasing engagement and participation (Oyelekan & Olorundare, 2020). ICT supports independent learning, self-paced exploration, and immediate feedback. This aligns with constructivist learning theories and improves students' motivation and attitudes towards Mathematics (Eze & Nwankwo, 2021).

Teachers reported that ICT aids in lesson preparation, presentation, and assessment, thereby increasing their effectiveness and motivation to teach Mathematics. While many teachers recognize ICT's benefits, its effective use still depends on their confidence and training. Teachers

with ICT training are more likely to integrate it effectively into their lessons (Nwabueze & Igwe, 2023).

Despite the benefits, challenges such as insufficient ICT infrastructure, lack of continuous teacher training, poor internet connectivity, and limited access to digital resources were major barriers to the effective use of ICT in Mathematics instruction. Findings revealed that many schools lack sufficient ICT infrastructure-computers, internet access, power supply, and educational software. This limits consistent usage of ICT in teaching Mathematics (Adu et al., 2022).

The findings revealed a gap in the full integration of ICT into the Mathematics curriculum, and a lack of strong policy frameworks to support sustainable ICT adoption. ICT is not yet fully integrated into the Nigerian Mathematics curriculum. There is also limited policy enforcement to ensure that ICT is used as a standard instructional tool in all schools (Adu & Adebanjo, 2020). Limited access to ICT tools outside the classroom affects students' ability to practice and reinforce mathematical skills learned through technology-enhanced lessons.

Conclusion

ICT tools positively impact Mathematics teaching by making abstract concepts more visual, interactive, and accessible. Students benefit from increased motivation, better understanding, and improved academic performance when ICT is used effectively. Despite these advantages, the use of ICT in many schools remains limited due to infrastructural and human capacity challenges. Therefore, the integration of ICT in Mathematics education is essential but must be supported with appropriate resources, training, and planning.

The findings of this study confirm that Information and Communication Technology (ICT) plays a crucial role in enhancing the teaching and learning of Mathematics. ICT tools such as interactive whiteboards, educational software (e.g., GeoGebra, Desmos), and projectors have been shown to make abstract mathematical concepts more visual, engaging, and understandable (Adedokun et al., 2022).

The study revealed that both teachers and students benefit significantly from ICT integration. Teachers are able to deliver lessons more effectively and creatively, while students show improved participation, motivation, and performance (Oyelekan & Olorundare, 2021). This supports the view that ICT can bridge the gap between traditional instruction and modern teach needs (Adu et al., 2020).

However, several challenges still limit the full adoption of ICT in Mathematics classrooms. These include inadequate infrastructure, limited teacher training, poor internet access, and lack of policy enforcement (Nwabueze & Igwe, 2023). Addressing these challenges is critical for sustainable ICT use in education. In conclusion, while ICT has the potential to transform Mathematics education, its effectiveness depends on proper implementation, teacher competence, and ongoing support. Integrating ICT into the curriculum, providing necessary resources, and strengthening policy frameworks will be essential to realizing its full impact in Nigerian schools and beyond.

Recommendations

1. Provision of ICT Facilities

The effective integration of ICT in the teaching and learning of Mathematics requires adequate infrastructure.

2. Teacher Training and Capacity Building

The success of ICT integration in Mathematics education depends largely on the competence and confidence of teachers in using technology. Many teachers lack the technical skills or experience needed to effectively operate ICT tools such as projectors, educational software, or online platforms. To address this, regular and targeted training workshops should be organized to help teachers: understand how to integrate ICT into lesson plans, use tools like GeoGebra, Desmos, and Excel in teaching math concepts and manage virtual classrooms and digital assessments.

3. Curriculum Integration

For ICT to effectively influence the teaching and learning of Mathematics, it must be fully integrated into the school curriculum. This means ICT should not be treated as a separate subject but as a tool embedded in the teaching of Mathematics at all levels.

4. Policy Support

The successful integration of ICT in Mathematics education requires strong and clear policy support from government and educational authorities. Policies should guide schools on how to implement, fund, and sustain ICT use in classrooms. Effective policy support includes: establishing national or state-level ICT in education policies, allocating budgets for ICT infrastructure and teacher training, setting standards for ICT use in teaching and learning, and ensuring monitoring and evaluation of ICT programs in schools. Without supportive policies, ICT initiatives may lack direction, funding, or accountability. Policies help create an enabling

environment where schools are encouraged and empowered to adopt technology meaningfully in Mathematics education.

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