

The Role of Digital Technology in Enhancing Mathematics Education in Senior Secondary Schools in Lere Local Government Area of Kaduna State

Mohammed, A. S. ; Jatto O. F.; and Shuaibu, S.

Department of Mathematics, Federal University of Education, Zaria.

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Abstract

The study was on the role of digital technology in enhancing mathematics education in senior secondary schools in Lere Local Government Area of Kaduna State, Nigeria. Three research objectives and three research questions guided the study. The review of literature in the study was organized under the following subheading-: Theoretical framework, conceptual framework, and review of related literature. Descriptive survey research design was adopted for the study. The sample for the study comprised of fifty-two (52) mathematics teachers drawn from the population of study using simple random sampling technique. The instruments for data collection in this study was a questionnaire titled, Roles of Digital Technology in Enhancing Mathematics Education Questionnaire (RDTEMEQ) and analyzed using mean and standard deviation via Statistical Package for the Social Sciences (SPSS, version 22). The results revealed that digital technology resources for teaching Mathematics in secondary schools within Lere LGA are largely unavailable ($X = 1.75$, $S.D = 1.10$), the extent of Mathematics teachers' utilization of digital technology in their instructional practices is generally low ($X = 2.16$, $S.D = 1.12$) and teachers face significant challenges in integrating digital technology into Mathematics education ($X = 3.83$, $S.D = 1.23$). The researcher recommended that the government and school administrators should invest in the provision of ICT infrastructure, including functional computers, internet access, and digital learning platforms, among others.

Keywords: Digital Technology, Mathematics Education, ICT Infrastructure, Teacher Utilization.

Introduction

Mathematics is a fundamental subject in the school curriculum, serving as the foundation for science, technology, engineering, and mathematics (STEM) disciplines. It plays a critical role in cognitive development, problem-solving, and logical reasoning, making it indispensable for students' academic and professional success (Adebayo & Yusuf, 2020). Despite its significance, mathematics education in Nigeria, particularly in senior secondary schools, faces several challenges, including low student engagement, poor comprehension of abstract concepts, and inadequate instructional resources. To address these challenges, digital technology has emerged as a transformative tool that enhances teaching and learning processes, making mathematics education more interactive, accessible, and effective (Ogunleye et al., 2021).

Digital technology encompasses a broad range of tools, including computers, mobile devices, digital projectors, interactive whiteboards, and online learning platforms. These

technologies facilitate instructional delivery, promote self-paced learning, and enhance students' understanding of mathematical concepts (Okonkwo & Adejumo, 2019). The integration of digital technology in mathematics education provides teachers with innovative teaching strategies such as simulations, virtual manipulatives, and gamification, which improve student engagement and motivation (Adamu et al., 2018; Eze & Nwogu, 2022). Studies have shown that technology-driven learning environments foster active participation, deepen conceptual understanding, and enhance problem-solving skills among secondary school students (Aliyu & Salisu, 2020). The role of digital technology in mathematics education is particularly crucial in Nigeria, where traditional teaching methods often rely on rote memorization and teacher-centered instruction. Many mathematics teachers in senior secondary schools still employ chalk-and-talk methods, limiting students' ability to explore mathematical ideas dynamically (Adebisi & Ojo, 2021). Digital tools such as computer-assisted instruction (CAI), multimedia presentations, and online learning platforms enable teachers to present abstract mathematical concepts in visually engaging ways, making them more comprehensible for students (Ogunniyi et al., 2022). Additionally, digital platforms provide students with opportunities for self-directed learning, allowing them to revisit lessons and practice problem-solving at their own pace (Yusuf & Bello, 2020).

Digital technology usage in mathematics teaching is still in its infancy in Kaduna State. Many schools still lack access to basic technical infrastructure, like computers, dependable internet connections, and energy, even though some have started incorporating digital tools into their teaching procedures (Adamu et al., 2022; Ibrahim & Musa, 2021). The success of technology-enhanced mathematics teaching is also greatly influenced by the preparedness and proficiency of teachers using digital technologies. In order to successfully incorporate technology into their teaching techniques, many maths instructors in Lere LGA need proper training and professional development because they have little exposure to digital teaching materials (Okafor & Nwachukwu, 2022). Furthermore, student attitudes towards digital learning influence the success of technology integration in mathematics education. Studies indicate that students who engage with digital resources exhibit higher levels of motivation, confidence, and interest in mathematics compared to those who rely solely on traditional methods (Adamu et al., 2018; Adamu & Oladipo, 2020). Digital platforms also enable collaborative learning, where students can interact with their peers, access online tutorials, and receive instant feedback on their progress (Edeh & Ugochukwu, 2021). However, challenges such as digital illiteracy, limited funding, and inadequate government policies on ICT integration in education hinder the full adoption of technology in mathematics instruction (Afolabi & Hassan, 2021).

Despite these challenges, the potential benefits of digital technology in enhancing mathematics education cannot be overlooked. The Nigerian government, through initiatives such as the National Policy on Information and Communication Technology (ICT) in Education, has emphasized the need for digital integration in secondary schools (Adamu et al. 2018). However, the implementation of these policies requires collaborative efforts

from stakeholders, including government agencies, school administrators, teachers, and private organizations, to ensure adequate funding, infrastructure development, and teacher training programs (Okon & Ekpo, 2021). Given the increasing importance of digital literacy in the 21st-century learning environment, the need to explore the role of digital technology in enhancing mathematics education in Lere LGA remains significant. This study aims to investigate the extent to which digital tools are integrated into mathematics instruction, assess their impact on students' learning outcomes, and identify the challenges associated with their implementation.

Objectives

- i. Assess the availability of digital technology resources for teaching mathematics in secondary schools within Lere LGA.
- ii. Evaluate the extent of utilization of these digital resources by mathematics teachers in Lere LGA.
- iii. Identify the challenges faced in integrating digital technology into mathematics education in Lere LGA.

Research Questions

To achieve the above objectives, the study will address the following research questions:

- i. What digital technology resources are available for teaching mathematics in secondary schools in Lere LGA?
- ii. To what extent do mathematics teachers utilize digital technology in their instructional practices in Lere LGA?
- iii. What challenges do teachers and students face in integrating digital technology into mathematics education in Lere LGA?

Methodology

The study employed a descriptive survey research design to examine the role of digital technology in enhancing mathematics education. The target population consisted of all senior secondary school mathematics teachers in Lere Local Government Area (LGA) of Kaduna State. Lere LGA had twenty-four (24) public senior secondary schools, with a total of sixty-two (62) mathematics teachers. These teachers were selected as the focus of the study because of their direct involvement in mathematics instruction and assessment at the senior secondary level. From this total population, the researchers selected fifty-two (52) mathematics teachers as the sample for the study. The sample size was determined using Krejcie and Morgan's (1970) sample size table, ensuring that it was adequately representative of the population. A simple random sampling technique was employed to eliminate bias and give all mathematics teachers an equal chance of being selected. This method ensured a fair distribution of respondents across the selected schools, thereby increasing the reliability and generalizability of the study's findings.

The primary instrument for data collection was a structured questionnaire titled "Roles of Digital Technology in Enhancing Mathematics Education Questionnaire (RDTEMEQ)." The questionnaire was designed to gather information on aspects that were not directly observable, such as teachers' perceptions, attitudes, and experiences regarding the use of digital technology in mathematics instruction. It comprised 21 items structured on a five-point Likert scale, with response categories ranging from Strongly Agree (SA), Agree (A), Undecided (UN), Disagree (D), to Strongly Disagree (SD). This format allowed for a nuanced understanding of respondents' opinions and ensured ease of data analysis. To ensure the validity of the questionnaire, two experienced science educators from the Science Education Department of the Federal University of Education, Zaria, reviewed the instrument. Their expert feedback was incorporated before the final administration of the questionnaire. The reliability of the instrument was tested using the test-retest method through a pilot study conducted in Zaria Local Government Area. The questionnaire was randomly administered to 20 senior secondary school mathematics teachers, and the Pearson Product-Moment Correlation Coefficient was used to analyze the results. A reliability coefficient of 0.78 was obtained, indicating that the instrument was reliable for the study.

Before data collection, the researcher obtained an official letter of introduction from the department and presented it to the Kaduna State Ministry of Education, Lere Quality Assurance Office, to seek approval for administering the questionnaire. The researcher personally distributed the questionnaires to mathematics teachers across the selected schools, ensuring direct engagement with respondents. Adequate time was given for completing the questionnaire, and efforts were made to retrieve responses on the spot to maximize the response rate. Respondents were assured of confidentiality to encourage honest and unbiased participation. The collected data were analyzed using descriptive statistical methods such as mean, and standard deviation. These statistical tools provided a comprehensive overview of the findings, allowing for meaningful conclusions about the impact of digital technology on mathematics education in the study area.

Results

Research Question One: What digital technology resources are available for teaching mathematics in secondary schools in Lere LGA?

Table 1: Available digital technology resources for teaching mathematics.

S/N	Item Statements	SA	A	UN	D	SD	X	S.D
1	My school has functional computers for mathematics instruction	2	8	0	15	27	1.85	1.14
2	Internet facilities are available for accessing digital mathematics resources.	4	1	0	18	29	1.73	1.18
3	Mathematics teachers have access to virtual labs and simulations	0	5	0	22	25	1.67	1.05
4	Projectors and interactive whiteboards are available for teaching mathematics.	9	7	0	10	26	2.06	1.28
5	E-books and digital mathematics textbooks are readily accessible to students.	4	3	0	17	28	1.79	1.18
6	My school subscribes to online mathematics learning platforms.	0	2	0	26	24	1.56	0.95
7	Adequate electricity supply supports the use of digital technology in mathematics classes.	0	1	3	23	25	1.58	0.93
	Cumulative Mean						1.75	1.10

KEY: SA – Strongly Agree, A – Agree, UN – Undecided, D – Disagree, SD – Strongly Disagree, X – Mean, S.D – Standard Deviation.

The findings indicate that digital technology resources for teaching mathematics in secondary schools within Lere LGA are largely unavailable. The cumulative mean score of 1.75 suggests that most respondents disagreed or strongly disagreed with the availability of these resources. Among the items assessed, the lowest mean score (1.56) was recorded for the availability of online mathematics learning platforms, indicating that such resources are almost non-existent. Similarly, the lack of adequate electricity supply (1.58) further constrains the integration of digital tools in Mathematics education. The highest mean score (2.06) was for projectors and interactive whiteboards, but the standard deviation (1.28) suggests variability in responses, implying that some schools might have limited access to these resources. Overall, the results highlight significant gaps in digital resource availability, which may negatively impact the effectiveness of digital technology in Mathematics instruction.

Research Question Two: To what extent do Mathematics teachers utilize digital technology in their instructional practices in Lere LGA?

Table 2: Extent of Mathematics teachers' utilization of digital technology in their instructional practices

S/N	Item Statements	SA	A	UN	D	SD	X	S.D
1	I use digital technology regularly in my Mathematics lessons.	10	7	4	15	16	2.35	1.36
2	I incorporate multimedia resources (videos, animations) in teaching Mathematics.	6	1	3	22	20	2.00	1.27
3	Virtual labs are part of my Mathematics practical sessions.	0	0	0	19	33	1.37	0.48
4	I encourage students to use digital tools for Mathematics assignments and research.	20	16	0	11	5	3.63	1.24
5	I receive training on how to integrate digital technology into Mathematics instruction.	10	9	1	15	17	2.40	1.39
6	I use educational apps and software to teach Mathematics concepts.	5	2	0	20	25	1.79	1.17
7	Digital assessments and quizzes are used to evaluate students' understanding of Mathematics.	0	1	3	23	25	1.56	0.94
	Cumulative Mean						2.16	1.12

KEY: SA – Strongly Agree, A – Agree, UN – Undecided, D – Disagree, SD – Strongly Disagree, X – Mean, S.D – Standard Deviation

The results indicate that the extent of Mathematics teachers' utilization of digital technology in their instructional practices is generally low, with a cumulative mean of 2.16. The lowest mean score (1.37) was recorded for the use of virtual labs in Mathematics practical sessions, showing that such resources are almost entirely absent from instructional activities. Similarly, digital assessments and quizzes (1.56) and the use of educational apps and software (1.79) were also rarely incorporated into teaching. On the other hand, the highest mean score (3.63) was recorded for encouraging students to use digital tools for assignments and research, suggesting that while teachers may not frequently use digital tools themselves, they still encourage students to engage with them. However, limited access to training on digital technology integration (2.40) and infrequent use of multimedia resources (2.00) further suggest that teachers lack the necessary skills and infrastructure to fully integrate digital technology into their Mathematics instruction. Overall, the findings highlight a significant gap in digital technology adoption in Mathematics education, likely due to infrastructural and training challenges.

Research Question Three: What challenges do teachers face in integrating digital technology into Mathematics education in Lere LGA?

Table 3: Challenges faced by teachers in integrating digital technology into Mathematics education.

S/N	Item Statements	SA	A	UN	D	SD	X	S.D
1	Lack of ICT infrastructure hinders the use of digital technology in Mathematics teaching.	21	18	0	5	8	3.85	1.19
2	Teachers lack adequate training on how to use digital technology for instruction.	28	11	0	9	4	3.98	1.18
3	Poor internet connectivity limits access to online Mathematics resources	22	15	0	12	3	3.83	1.19
4	High cost of digital devices prevents their adoption in Mathematics education.	29	7	0	6	10	3.85	1.39
5	Students are not familiar with digital learning tools in Mathematics.	17	12	3	11	9	3.31	1.36
6	Frequent power outages disrupt the use of digital technology in teaching Mathematics	31	16	0	4	1	4.37	0.93
7	School administrators do not prioritize investment in digital learning resources.	20	18	0	3	11	3.62	1.36
	Cumulative Mean						3.83	1.23

KEY: SA – Strongly Agree, A – Agree, UN – Undecided, D – Disagree, SD – Strongly Disagree, X – Mean, S.D – Standard Deviation

The results indicate that teachers face significant challenges in integrating digital technology into Mathematics education, as reflected in the high cumulative mean of 3.83. The most critical challenge appears to be frequent power outages, which received the highest mean score (4.37), suggesting that unstable electricity supply severely limits the effective use of digital tools in Mathematics instruction. Other major barriers include lack of ICT infrastructure (3.85), high cost of digital devices (3.85), and poor internet connectivity (3.83), indicating that technological and financial constraints significantly hinder digital adoption in schools. Additionally, insufficient training for teachers (3.98) shows that even when digital tools are available, many educators lack the necessary skills to integrate them effectively into their teaching practices. Furthermore, school administrators' lack of prioritization (3.62) suggests an institutional gap in funding and supporting digital learning initiatives. Meanwhile, students' unfamiliarity with digital learning tools (3.31) highlights the need for more exposure and training for learners.

Discussion of Results

The study's findings illuminate several critical challenges in integrating digital technology into Mathematics education within Lere Local Government Area (LGA), reflecting broader trends observed in various regions of Nigeria. The study reveals a significant scarcity of digital technology resources for teaching Mathematics in secondary schools within Lere LGA. This finding aligns with research by Egbunu (2024), who reported that many secondary schools in Abuja Municipal Area Council lack essential digital tools necessary for

effective Mathematics instruction. Similarly, Eneogu et al. (2021) found inadequate availability of digital technologies in teaching and learning Economics at the University of Nigeria, Nsukka, hindering the educational process. Additionally, Festus (2023) observed that senior secondary schools in Kaduna Metropolis faced challenges due to insufficient Information Communication Technology (ICT) facilities for teaching Mathematics. These studies collectively suggest a widespread deficiency of digital resources across Nigerian educational institutions.

The research indicates that Mathematics teachers' utilization of digital technology in instructional practices is generally low. This observation is supported by Egbunu (2024), who noted that Mathematics teachers in Abuja Municipal Area Council seldom incorporate digital tools into their teaching methodologies. Similarly, Okeke-Ezenyanwu (2023) reported limited use of ICT facilities by teachers in secondary schools in Kaduna State, often due to a lack of proficiency and confidence in using these technologies. Furthermore, Itighise and Ogbole (2023) found that science educators in South-South Nigeria underutilized ICT facilities for mastery learning in the post-COVID-19 era, highlighting a broader trend of low digital technology integration in teaching practices.

Teachers face considerable challenges in integrating digital technology into Mathematics education. According to Adamu et al (2022) and Egbunu (2024), major constraints include the high cost of internet subscriptions and slow internet speeds, which impede the effective use of digital tools in teaching. Eneogu et al. (2021) identified challenges such as inadequate ICT infrastructure and insufficient training for lecturers and students, hindering the effective utilization of digital technologies in education. Additionally, Festus (2023) highlighted that the lack of adequate ICT facilities and training opportunities for teachers in Kaduna Metropolis posed significant barriers to integrating digital technology into Mathematics instruction. These challenges underscore the need for comprehensive strategies to address infrastructural deficits and capacity-building initiatives to enhance digital technology integration in education.

Conclusion

The findings of this study highlight the critical gaps in the availability, utilization, and integration of digital technology in Mathematics education within secondary schools in Lere Local Government Area. The results indicate that most schools lack essential digital resources, such as functional computers, internet facilities, virtual labs, and digital learning platforms. Additionally, the low level of digital technology utilization among Mathematics teachers suggests that even when some resources are available, they are not effectively integrated into instructional practices. This further limits students' exposure to digital learning tools, reducing opportunities for interactive and technology-enhanced learning experiences. Furthermore, the study reveals that teachers encounter significant challenges in adopting digital technology, including inadequate infrastructure, lack of training, poor internet connectivity, and frequent power outages. These barriers hinder the effective implementation of digital tools in Mathematics instruction. To bridge this gap, urgent

interventions are needed from stakeholders, including the government, school administrators, and private organizations, to improve digital infrastructure, provide capacity-building programs for teachers, and create policies that support the seamless integration of technology in education. By addressing these issues, the quality of Mathematics education can be significantly enhanced, ultimately improving students' engagement and academic performance.

Recommendations

The study wishes to make the following recommendations:

- i. The government and school administrators should invest in the provision of ICT infrastructure, including functional computers, internet access, and digital learning platforms.
- ii. Regular training and professional development workshops should be organized for Mathematics teachers to enhance their skills in utilizing digital technology effectively.
- iii. The Ministry of Education should develop policies that mandate the integration of digital technology in science education.

References

- Adamu T. I., Ibrahim M. S., Adamu T. A., & Ibrahim A. (2018). Use of Audio-Visual Materials in Teaching and Learning of Classification of Living Things among Secondary School Students in Sabon Gari LGA of Kaduna State. *Plant. 6*, (2), 33-37.
- Adamu, H., & Oladipo, K. (2020). *Student motivation and digital learning in Nigerian secondary schools: A case study of mathematics classrooms. International Journal of Educational Technology*, 7(3), 112-129.
- Adamu, T. A., Alafiatayo, B. M., & Adamu, T. I. (2022). Impact of Internet Use on Mathematics Students' Academic Performance in Zaria, Kaduna State. *African Journal of Humanities and Contemporary Education Research*, 3(2), 120–128.
- Adebayo, T., & Yusuf, R. (2020). *Mathematics education and cognitive development in secondary schools: A pedagogical approach. Journal of Educational Research*, 15(2), 45-60.
- Adebisi, J., & Ojo, M. (2021). *Traditional versus digital instructional methods in secondary school mathematics: A comparative study. African Journal of Mathematics and Science Education*, 9(1), 34-48.
- Afolabi, T., & Hassan, S. (2021). *ICT integration in Nigerian secondary schools: Challenges and policy implications. Educational Technology Review*, 11(4), 78-95.
- Aliyu, M., & Salisu, A. (2020). *Digital tools and problem-solving skills among mathematics students in Northern Nigeria. Journal of STEM Education*, 6(2), 90-105.
- Edeh, C., & Ugochukwu, P. (2021). *The impact of digital learning on student engagement in mathematics education: An empirical study in Nigerian schools. West African Journal of Education*, 18(1), 55-72.
- Egbunu, R. (2024). Utilization of digital tools in teaching and learning of Mathematics in senior secondary schools in Abuja Municipal Area Council, Federal Capital Territory, Abuja. *Journal of Continuing and Development Education*, 4(2), 18–25.

- Eneogu, N. D., Eze, T. I., & Okeke, M. C. (2021). Availability and utilization of digital technologies in the teaching and learning of Economics at the University of Nigeria, Nsukka. *Journal of Educational Research and Development*, 5(1), 45–58.
- Eze, F., & Nwogu, J. (2022). *Technology-enhanced mathematics education: The role of digital simulations and gamification*. *Journal of Educational Innovation*, 5(2), 101-118.
- Festus, A. B. (2023). Investigating the availability and utilization of information communication technology (ICT) facilities for teaching Mathematics in senior secondary schools within Kaduna Metropolis. *Journal of Education in Developing Areas*, 32(1), 243–256.
- Ibrahim, A., & Musa, H. (2021). *Assessing the availability and utilization of digital resources in secondary schools: A study of Lere Local Government Area, Kaduna State*. *Nigerian Journal of Digital Education*, 4(1), 67-84.
- Itighise, A. E., & Ogbole, P. O. (2023). Science educators' utilization of ICT facilities for mastery learning in post-COVID-19 era in selected universities in South-South Nigeria. *Journal of Qualitative Education*, 15(1), 301–317.
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607-610.
- Ogunleye, R., Ojo, B., & Salami, K. (2021). *Enhancing mathematics instruction through technology: Best practices and challenges in Nigerian schools*. *Journal of Educational Technology and Innovation*, 10(3), 88-102.
- Ogunniyi, S., Bello, Y., & Nwachukwu, E. (2022). *Teachers' perspectives on the use of digital tools in mathematics education: A survey of Nigerian secondary schools*. *African Journal of Educational Studies*, 14(2), 130-145.
- Okafor, J., & Nwachukwu, L. (2022). *Professional development and teachers' readiness for ICT integration in mathematics classrooms*. *International Journal of Digital Learning*, 8(2), 55-70.
- Okeke-Ezenyanwu, R. N. (2023). The role of information and communication technology (ICT) research and problem-solving competencies on business teacher education for employability in tertiary institutions in Anambra State. *COOU Journal of Educational Research*, 3(2), 112–126.
- Okon, E., & Ekpo, F. (2021). *Public-private partnerships in ICT education: A strategy for sustainable digital learning in Nigerian secondary schools*. *Journal of Policy and Education Development*, 7(1), 34-50.
- Okonkwo, P., & Adejumo, T. (2019). *The impact of e-learning platforms on students' mathematical problem-solving skills in Nigeria*. *Journal of Mathematics Education Research*, 12(4), 210-225.
- Yusuf, R., & Bello, M. (2020). *The role of self-directed learning in digital mathematics education: Evidence from Nigerian classrooms*. *Journal of Educational Psychology and Technology*, 9(1), 75-89.