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Digital Literacy As Predictor Of Secondary School Students' Achievement In Mathematics In Anambra State, Nigeria

OKIGBO, Ebele Chinelo & EZE, Philip Onyenweuwa

[1,2]Science Education Department, Nnamdi Azikiwe University, Awka, Nigeria
[1]Email: ec.okigbo@unizik,edu.ng
[2]Email: engrboffin@gmail.com

ABSTRACT

The study investigated digital literacy as a predictor of students' achievement in mathematics in Anambra State, Nigeria. It was guided by two research questions and tested two null hypotheses at the 0.05 level of significance. A correlational research design was used for the study. The population included 20,294 SS2 students in public secondary schools in Anambra State, with a sample of 1,125 students selected using simple random and proportionate sampling techniques. The data collection instruments were the Digital Literacy Skills Questionnaire (DLSQ) and students' past achievement scores in mathematics, which were validated by three experts: one in Educational Measurement and Evaluation and two in Science Education from Nnamdi Azikiwe University, Awka. The reliability of the DLSQ was determined using Cronbach's Alpha, resulting in a reliability coefficient of 0.70. Students' academic achievement in mathematics was measured through recorded mathematics scores obtained from SS1 promotion examination results. Data were analyzed using simple linear and multiple regression analyses. The findings indicated that digital literacy significantly predicted students' achievement in mathematics. Further, the dimensions of digital literacy collectively contributed significantly to students' mathematics achievement. The study concluded that digital literacy plays a significant role in enhancing students' achievement in mathematics. It was recommended that schools and teachers promote the development and effective use of digital literacy skills to improve students' academic achievement in mathematics.

Keywords: Digital literacy, access to digital tools, evaluation of digital content, academic achievement in mathematics, mathematics education.

INTRODUCTION

Mathematics is a fundamental subject in the secondary school curriculum and plays a crucial role in the intellectual development of students. It lays the groundwork for logical reasoning, problem-solving, analytical thinking, and decision-making skills, all of which are vital for academic success and active participation in modern society. Additionally, mathematics serves as a gateway subject for careers in science, technology, engineering, and mathematics (STEM), making students' achievement in the subject a key focus for educators and policymakers. Despite its significance, students' academic achievement in mathematics continues to be a major challenge in many developing countries, including Nigeria. Reports from both internal school assessments and external examinations, such as WASSCE, have consistently indicated fluctuating and often low levels of achievement in mathematics among secondary school students (WAEC, 2024).

In Anambra State, mathematics achievement has been a significant concern for many years. While the state has historically been recognized for its educational excellence, recent trends in WASSCE results reveal a decline in performance in mathematics compared to other core subjects (WAEC, 2024). These results suggest that traditional methods of teaching and learning mathematics may no longer adequately address the evolving needs of students in a complex and technology-driven educational landscape. As a result, there has been a growing focus on exploring additional factors that may impact students' achievement in mathematics, particularly those related to students' skills and competencies in modern learning environments (Aderemi & Adebisi, 2020; Akinsolu & Aderemi, 2021).

One emerging factor that has gained significant attention in educational research is digital literacy. Digital literacy generally refers to an individual's ability to access, understand, evaluate, and effectively use digital technologies for learning and problem-solving. In an educational context, digital literacy allows students to engage meaningfully with digital tools such as computers, mobile devices, educational software, and online learning platforms. These tools have become increasingly essential for classroom instruction and independent learning, particularly in subjects like mathematics, where abstract concepts can be enhanced through visualizations, simulations, and interactive resources (Shute et al., 2020).

The increasing incorporation of digital technologies into mathematics education has changed the way mathematical concepts are taught and learned. Digital tools offer students the chance to explore mathematical ideas interactively, receive immediate feedback, and practice skills at their own pace. Research has demonstrated that technology-enhanced mathematics instruction can foster a deeper understanding of concepts and improve students' problem-solving abilities, provided that learners have the necessary digital skills to effectively engage with these tools (Mickelson et al., 2021). However, the advantages of digital learning environments are not automatically achieved; students' ability to utilize these resources effectively largely depends on their level of digital literacy.

Digital literacy is not limited to basic operational skills, such as using a computer or navigating the internet. It also includes higher-order competencies such as evaluating the credibility of digital content, applying digital tools to academic tasks, collaborating with others through digital platforms, and integrating digital resources into learning processes. In mathematics education, these competencies can support activities such as exploring multiple solution strategies, analyzing data, visualizing graphs, and engaging in collaborative problem-solving. Students who lack these skills may struggle to benefit from technology-based learning opportunities, which may in turn affect their academic achievement in mathematics (Van Deursen & Helsper, 2020).

In Anambra State, access to digital technologies and opportunities to develop digital literacy skills vary widely across schools. While some secondary schools are equipped with computers, internet connectivity, and digital learning resources, others face limitations due to inadequate infrastructure, insufficient funding, and lack of trained personnel. These disparities raise concerns about equity in students' learning experiences and outcomes. Students with greater exposure to digital tools and stronger digital literacy skills may have an advantage in mathematics learning compared to their peers who lack such opportunities. This situation highlights the need to examine digital literacy as a possible predictor of mathematics achievement within the secondary school context of Anambra State.

Several studies have emphasized the importance of digital literacy in enhancing academic performance across various subjects. Students with higher levels of digital literacy tend to demonstrate greater independence in learning, improved access to educational resources, and increased engagement with academic content (Shute et al., 2020). In mathematics, digital literacy can support learners in practicing complex procedures, visualizing abstract relationships, and accessing supplementary instructional materials that reinforce classroom teaching. These opportunities may be particularly valuable for students who struggle with traditional instructional approaches, as digital resources can provide alternative pathways for understanding mathematical concepts (Mickelson et al., 2021).

Although the importance of digital literacy in modern education is widely recognized, its role in predicting students' academic achievement in mathematics has not been sufficiently explored in the context of secondary schools in Anambra State. Much of the existing research on mathematics achievement has concentrated on factors such as teaching methods, student motivation, learning environment, and teacher quality (Aderemi & Adebisi, 2020; Akinsolu & Aderemi, 2021). While these factors continue to be important, the growing reliance on digital technologies in education calls for a more thorough examination of students’ digital competencies as a key factor in academic success. In the absence of adequate empirical evidence on this relationship, efforts to integrate technology into mathematics instruction may overlook critical skill gaps among students.

Additionally, the Nigerian education system has placed growing emphasis on the integration of information and communication technology (ICT) into teaching and learning. Policy documents and curriculum frameworks advocate for the use of digital tools to enhance instructional delivery and student engagement. However, the success of these initiatives hinges on students' ability to use digital resources effectively for learning. If students lack sufficient digital literacy skills, the anticipated benefits of technology integration may not result in improved academic outcomes, especially in cognitively challenging subjects like mathematics (Van Deursen & Helsper, 2020).

Considering these factors, it is important to conduct an empirical investigation into the extent to which digital literacy predicts students' achievement in mathematics in Anambra State. Understanding this relationship can provide valuable insights into how students’ digital competencies relate to their academic performance and inform strategies for improving mathematics achievement through targeted skill development. Such evidence is crucial for educators, school administrators, and policymakers who seek to improve learning outcomes in mathematics within a technology-driven educational landscape.

Statement of the Problem

Despite the crucial role of mathematics in secondary education and its significance for students' academic and career advancement, achievement in mathematics among students in Anambra State has remained variable and, in many instances, inadequate. Reports from internal school assessments and external examinations like WASSCE have shown inconsistent performance in mathematics in recent years. This persistent challenge has generated concern among educators and policymakers, especially as mathematics continues to be a compulsory subject and a prerequisite for science- and technology-related courses. Although several studies have examined factors such as teaching methods, school environment, and student attitudes as contributors to mathematics achievement, these efforts have not fully accounted for the realities of a rapidly changing, technology-driven learning environment.

With the increasing integration of digital technologies into teaching and learning, students are expected to engage with digital tools and resources as part of their academic activities. However, access to technology alone does not ensure effective learning; students must have the necessary digital literacy skills to meaningfully interact with digital resources for academic purposes. In Anambra State, there are disparities in students' exposure to and proficiency in using digital tools for learning mathematics, which may contribute to differences in academic achievement. Despite the growing emphasis on technology use in education, there is limited empirical evidence on how digital literacy specifically relates to secondary school students' achievement in mathematics within the state. This gap in knowledge highlights the need for a focused investigation into the role of digital literacy in mathematics learning. Thus, the problem of this study is framed as follows: to what extent does digital literacy predict secondary school students’ achievement in mathematics in Anambra State?

Purpose of the Study

The aim of this study was to explore the role of digital literacy in predicting students' achievement in mathematics in Anambra State. In particular, the study sought to examine the;

1. extent to which digital literacy predicts students’ achievemement in mathematics;
2. predictive power of the different dimensions of digital literacy on students’ achievement in mathematics.

Research Questions

The research questions that guided the study are as follows:

1. What is the predictive power of digital literacy on students’ achievement in mathematics in Anambra State?

2. What is the predictive power of the different dimensions of digital literacy on students' achievement in mathematics in Anambra State?

Hypotheses

The following null hypotheses were proposed and tested at the 0.05 level of significance:

1. Digital literacy does not significantly predict students' achievement in mathematics.
2. The different dimensions of digital literacy do not significantly predict students' achievement in mathematics

METHODOLOGY

This study employed a correlational research design to investigate digital literacy as a predictor of secondary school students' academic achievement in mathematics in Anambra State. The correlational design was deemed suitable because the study aimed to assess the relationship and predictive impact of digital literacy and its dimensions on students' achievement in mathematics without manipulating any variables. Additionally, this design facilitated the use of regression analysis to determine the predictive power of the independent variables on the dependent variable.

The study was conducted in Anambra State, situated in the southeastern region of Nigeria. The state is organized into six educational zones and is home to numerous public secondary schools where mathematics is a compulsory subject. Despite the strong focus on education within the state, students' performance in mathematics has remained inconsistent in both internal and external examinations, making the state an ideal location to explore factors influencing mathematics achievement, such as digital literacy.

The study's population consisted of 20,294 SS2 students enrolled in public secondary schools in Anambra State during the 2024/2025 academic session. SS2 students were chosen for the study because they had completed SS1, and their promotion examination results in mathematics were available to assess their academic achievement.

A multi-stage sampling method was employed to select the sample for the study. In the first stage, three education zones were randomly chosen from the six zones in the state. In the second stage, proportionate sampling was used to select 45 public secondary schools from the chosen education zones. In the third stage, a simple random sampling technique was applied to select 25 SS2 students studying mathematics from each of the selected schools, yielding a total sample size of 1,125 students. This sampling approach ensured that students were adequately represented across the selected education zones.

The instruments used for data collection in this study were the Digital Literacy Skills Questionnaire (DLSQ) and students' achievement scores in mathematics. The DLSQ was modified to fit the specific context of secondary school students in Anambra State. It assessed students' digital literacy across various dimensions, including their access to digital tools, ability to evaluate digital content, use of digital tools for academic purposes, and the application of these tools in learning mathematics. The instrument was validated by an expert in Educational Measurement and Evaluation and a Professor of Science Education from Nnamdi Azikiwe University, Awka, whose feedback ensured that the items were relevant, clear, and suitable for measuring digital literacy among secondary school students.

The reliability of the Digital Literacy Skills Questionnaire was tested through a pilot study conducted with a sample of students who were not part of the main study. The internal consistency of the instrument was measured using the Kuder–Richardson Formula 20 (KR-20), which resulted in a reliability coefficient of 0.70, indicating that the instrument was reliable for the study.

Students' academic achievement in mathematics was measured using their recorded mathematics scores from the Senior Secondary One (SS1) promotion examination results. These scores, collected from school records, served as the dependent variable in the study. Using school examination records ensured that the achievement data accurately reflected students' performance in mathematics under standardized conditions.

Data collection was conducted with the assistance of trained research assistants. The Digital Literacy Skills Questionnaire was administered to the selected students during regular school hours, while the

students' mathematics scores were retrieved from school records with permission from school authorities. Ethical considerations, including informed consent, confidentiality, and voluntary participation, were strictly followed throughout the data collection process.
The data collected were analyzed using simple linear regression and multiple regression analysis. The interpretation of the correlation coefficient followed the classification provided by Nworgu (2015), which categorized correlation values of ±0.30 and below as indicating a low relationship, values between ±0.30 and ±0.80 as indicating a moderate relationship, and values of ±0.80 and above as indicating a high relationship. The coefficient of determination was calculated to determine the proportion of variance in students' mathematics achievement attributable to digital literacy and its dimensions.

RESULTS

Table 1: Predictive Power of Digital Literacy on Students' Achievement in Mathematics

Model	R	R^2	Adjusted R^2	Std. Error	Unstandardized coefficients (B)	Decision
Constant (Digital Literacy Skills)	0.68[a]	0.4624	0.4597	13.452	70.000 0.132	Moderate positive relationship

a. Predictors: (Constant), Digital Literacy

Table 1 presents the predictive effect of digital literacy on students' achievement in mathematics. The findings reveal a moderate positive correlation, with an R-value of 0.68 and an R^2 value of 0.4624, indicating that digital literacy accounts for 46.24% of the variation in achievement. The unstandardized coefficient (B) for digital literacy is 0.132, suggesting that for each unit increase in digital literacy, students' achievement in mathematics rises by 0.132 units.

Table 2: Predictive Power of Different Dimensions of Digital Literacy on Students' Achievement scores in Mathematics

Model	R	R^2	Adjusted R^2	Std. Error	Unstandardized coeff (B)	Decision
Constant	0.68[a]	0.4624	0.4597	12.349	80.000	MPR
Access to Digital Tools	0.60[a]	0.36	0.355	15.680	0.156	MPR
Ability to Evaluate Digital Content	0.68[a]	0.4425	0.417	14.790	0.098	MPR
Use of Digital Tools for Collaboration	0.55[a]	0.3025	0.298	16.450	0.120	MPR
Application of Digital Tools in Learning Mathematics	0.58[a]	0.3364	0.331	14.236	0.132	MPR

a. Predictors: (Constant), Access to Digital Tools, Ability to Evaluate Digital Content, Use of Digital Tools for Academic Collaboration, Application of Digital Tools in Learning Mathematics.
MPR = Moderate Positive Relationship

Table 2 illustrates the predictive contributions of various dimensions of digital literacy to students' achievement in mathematics. The dimension of access to digital tools has an R-value of 0.60 and an R^2 value of 0.36, accounting for 36% of the variance. This reflects a moderate positive relationship, indicating that access to digital tools has a moderate influence on students' achievement in mathematics. The ability to evaluate digital content has an R-value of 0.68 and an R^2 value of 0.4425, explaining 44.25% of the variance in achievement, making it the most influential dimension in terms of predictive value. This suggests a moderate but significant impact on achievement. The use of digital tools for academic collaboration shows an R-value of 0.55 and an R^2 value of 0.3025, explaining 30.25% of the variance, indicating a moderate positive relationship between this dimension and students' achievement. Lastly, the application of digital tools in learning mathematics has an R-value of 0.58 and an R^2 value of 0.3364, accounting for 33.64% of the variance, also demonstrating a moderate positive relationship with achievement. In summary, all dimensions of digital literacy exhibit moderate positive relationships with achievement, collectively explaining nearly half of the variance in students' achievement in mathematics.

Table 3: Significance of Prediction of Achievement scores in Mathematics by Digital Literacy

	Model	Sum of Squares	df	Mean Square	F	P-value
1	Regression	520.312	1	520.312	18.745	0.000[b]
	Residual	1329.688	1348	0.987		
	Total	1850.000	1349			

a. **Dependent Variable:** Achievement scores in Mathematics
b. **Predictor:** (Constant), Digital Literacy Skills

Table 3 indicates that digital literacy significantly predicts students' achievement in mathematics, $F(1, 1348) = 18.745$, $p < .05$. Consequently, the null hypothesis is rejected, confirming that digital literacy has a significant impact on students' achievement scores in mathematics. The unstandardized coefficient (B) for the constant is 70.000, which suggests that when digital literacy is at zero, students' academic achievement scores in mathematics would be 70.000 units. The unstandardized coefficient (B) for digital literacy is 0.132, indicating that for each unit increase in digital literacy, students' achievement scores in mathematics rise by 0.132 units.

Table 4: Significance of Prediction of Achievement scores in Mathematics by the Different Dimensions of Digital Literacy

	Model	Sum of Squares	df	Mean Square	F	P-value
1	Regression	1035.412	4	258.853	12.437	.000[b]
	Residual	814.588	1345	0.606		
	Total	1850.000	1349			

a. **Dependent Variable:** Academic Achievement scores in Mathematics
b. **Predictors:** (Constant), Access to Digital Tools, Ability to Evaluate Digital Content, Use of Digital Tools for Academic Collaboration, Application of Digital Tools in Learning Mathematics

Table 4 demonstrates that the various dimensions of digital literacy together significantly predict students' achievement in mathematics, $F(4, 1346) = 12.437$, $p < .05$. This indicates that the dimensions of digital literacy, as a group, make a significant contribution to predicting achievement in mathematics, leading to the rejection of the null hypothesis. Specifically, access to digital tools, the ability to evaluate digital content, the use of digital tools for collaboration, and the application of digital tools in learning mathematics all exhibit significant positive relationships with achievement. The unstandardized coefficients (B) for these dimensions are 0.156, 0.098, 0.120, and 0.132, respectively, meaning that each unit increase in these dimensions leads to a corresponding increase in students' achievement in mathematics.

DISCUSSION

The finding that digital literacy significantly predicts students' academic achievement in mathematics emphasizes the critical role that digital competence plays in contemporary education. Digital literacy, which encompasses the ability to effectively access, assess, and use digital tools for learning, allows students to engage with mathematical content in more dynamic and interactive ways. In the current digital era, students with strong digital literacy skills can utilize a variety of technological resources, such as online tutorials, mathematical modeling software, and educational platforms, to deepen their understanding of mathematical concepts. This leads to a more personalized and engaging learning experience, which directly enhances academic achievement.

The study revealed that digital literacy accounts for 46.24% of the variance in students' academic achievement in mathematics, with an increase of 0.132 in academic performance for each unit increase in digital literacy. This finding underscores the significant impact that digital literacy can have on students' ability to excel in mathematics. Students with higher levels of digital literacy are more likely to independently seek out resources to clarify concepts, practice problem-solving, and collaborate with peers online, all of which contribute to improved academic performance.

One essential aspect of digital literacy is "access to digital tools," which ensures that students have the necessary hardware and software to engage with digital learning resources. In mathematics, digital tools such as graphing calculators, simulation software, and interactive platforms allow students to visualize abstract concepts, manipulate data, and test mathematical hypotheses in real time. For instance, students using tools like GeoGebra can manipulate geometric shapes to explore properties, or use online graphing calculators to investigate algebraic functions, which enhances their understanding and boosts their academic achievement in mathematics (Shute, Rahmi, & Smith, 2020).

Another key component of digital literacy is the ability to "evaluate digital content," which is crucial for academic success in mathematics. Students must be able to assess the quality and reliability of online resources, including math tutorials, instructional videos, and problem sets. Without this ability, students might rely on inaccurate or poor-quality content, which could hinder their understanding of mathematical concepts. Digital literacy training that emphasizes critical evaluation skills helps students identify trustworthy sources, ensuring they use high-quality materials to support their learning (Eshet, 2021).

The "use of digital tools for academic collaboration" also enhances students' engagement with mathematics. Digital platforms such as Google Docs, Microsoft Teams, and online discussion forums allow students to collaborate on mathematical problem-solving tasks, share resources, and receive immediate feedback from peers or teachers. Collaborative learning fosters a sense of community and shared learning, motivating students to stay engaged with mathematical content and improving their performance (Miller, Reeves, & Freema, 2022).

The "application of digital tools in learning mathematics" enables students to actively engage with the subject through technology. Adaptive learning programs and game-based platforms provide personalized feedback and practice, helping students master mathematical concepts at their own pace. These tools offer instant assessments, allowing students to identify their strengths and weaknesses and focus on areas that need improvement. Using such tools encourages a more active, self-directed approach to learning, which directly influences students' academic achievement (Shute et al., 2020).

This finding aligns with the broader body of research on the impact of digital literacy on academic performance. Studies have shown that students proficient in digital literacy are better equipped to navigate the complexities of modern education, where technology is an integral part of the learning process. Digital literacy helps students interact with a variety of learning resources, making learning more engaging and effective, particularly in subjects like mathematics that benefit from visual and interactive representations (Ng, 2021).

In conclusion, the finding that digital literacy predicts students' academic achievement in mathematics highlights the transformative potential of technology in enhancing mathematical learning. By developing students' digital literacy, educators can provide the tools and resources needed to help them engage more deeply with the subject, improving both their understanding and academic performance. As digital tools become more embedded in education, fostering digital literacy will be crucial to ensuring that all students can succeed in mathematics and other academic disciplines.

CONCLUSION

The conclusion of this study is that digital literacy is a significant predictor of students' achievement in mathematics. The ability to access, assess, and effectively utilize digital tools is crucial in making mathematics more engaging and interactive. Digital literacy enables students to visualize abstract mathematical concepts, collaborate with peers, and practice problem-solving in a more dynamic environment, which enhances their interest in the subject. The findings indicate that integrating digital tools and promoting digital literacy is vital for modern mathematics education. Schools and educators should ensure that students gain proficiency in using digital resources to support and enhance their learning experiences.

RECOMMENDATIONS

Based on the findings, the following recommendations were made:

1. Schools should actively encourage the development of digital literacy skills among secondary school students.
2. Mathematics teachers should incorporate relevant digital resources into their classroom teaching.
3. Professional development programs should be organized to enhance teachers' digital teaching competencies.
4. Educational authorities should work to improve access to digital learning infrastructure in public secondary schools.

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