

# Impact of Digital Diversity on the Academic Performance of Rural Students in Gwagwalada Area Council, Abuja, FCT, Nigeria

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## Abstract

*The integration of digital technology in education has significantly influenced students' academic performance worldwide. However, disparities in digital access remain a major challenge, particularly in rural areas. This study examines the impact of digital diversity on the academic performance of rural secondary school students in Gwagwalada Area Council, Abuja. Despite the growing importance of digital tools in education, rural students continue to face challenges related to internet access, availability of digital devices, and digital literacy. This digital divide limits their ability to engage in online learning, research, and academic collaboration, negatively affecting their performance. The study employed a mixed-method research design, integrating quantitative surveys with qualitative interviews to assess students' access to digital resources, their frequency of use, and the impact on academic performance. Descriptive statistics, regression analysis, and thematic analysis were used to analyze the data. The results indicate that students with higher digital access perform better academically, with regression analysis showing a significant correlation between digital literacy, internet connectivity, and students' grades ( $R^2 = 0.62, p < 0.001$ ). Interviews with teachers and parents highlighted challenges such as poor infrastructure, high data costs, and lack of ICT training for educators. The study emphasizes the need for government intervention to improve digital infrastructure, teacher ICT training, and access to affordable digital devices. Addressing these issues will enhance digital inclusivity and improve academic performance in rural schools.*

**Keywords:** Digital Diversity, Academic Performance, Rural Education, Digital Literacy, Nigeria

## INTRODUCTION

Access to technology resources has emerged as a critical factor in determining academic success in the digital age. The use of digital tools in the classroom has completely changed how learners' study and given them access to a wealth of information outside of the traditional classroom. To influence students' academic performance, digital diversity—which includes things like internet connectivity, the availability of digital devices, digital literacy levels, and the incorporation of instructional technology—has become essential. Disparities in digital access still exist, though, especially between students in urban and rural areas. Students in many Nigerian rural communities, like Gwagwalada Area Council in Abuja, struggle to access digital resources, which has an impact on their academic performance and learning experiences. The idea of digital diversity stems from the more general framework of digital inclusion, which stresses that all people, regardless of socioeconomic background, have equal access to

technology. Digital inclusion is essential for closing the educational opportunity gap and guaranteeing that students from underserved places can compete on an equal basis with their urban counterparts, claim Olusola and Alabi (2023). The situation in Nigeria, however, is very different, with students in rural areas facing challenges such as poor internet connectivity, limited access to energy, and a dearth of digital learning resources (Ibrahim & Oyetade, 2022). The quality of education is greatly impacted by the digital divide as it restricts students' access to research, virtual learning, and the development of vital digital skills required for both academic success and future employment prospects.

Digital access and academic achievement are strongly correlated, according to empirical research. According to a study by Adegbite et al. (2021), students who regularly use digital learning resources like Coursera, Google Classroom, and online libraries outperform those who only use conventional teaching techniques in the classroom. Additionally, digital literacy abilities improve students' comprehension and retention rates by enhancing their capacity to absorb information quickly (Owolabi and Eze, 2022). However, because of the structural obstacles preventing digital connectivity, these advantages are still mostly theoretical for pupils in remote places like Gwagwalada. Nigeria has implemented several programs, such as the Universal Service Provision Fund (USPF) and the National Broadband Plan, to improve digital inclusion in education. Despite their efforts to close the digital divide, these programs have not had enough of an impact on pupils in rural areas (Okafor, 2023). Students in Gwagwalada are unable to take advantage of e-learning possibilities since many secondary schools lack the infrastructure required to facilitate digital learning. It is challenging to successfully incorporate technology into the curriculum in these schools since teachers frequently lack basic digital abilities (Adebayo et al., 2023). Furthermore, the issue is made worse by the socioeconomic status of many rural pupils, since many families are still unable to afford the high cost of digital gadgets and internet connections (Balogun & Adediran, 2022).

Rural students are severely disadvantaged by their inability to access these resources, especially in light of the swift transition to digital-based education. The COVID-19 epidemic further highlighted the shortcomings of rural education institutions, making it impossible for students to engage in remote learning without access to digital resources. According to research by Nwachukwu and Bello (2023), the educational gap widened even further when more than 60% of children in rural Nigeria were excluded from virtual learning programs during school closures. Students in rural areas will continue to do worse academically than their peers in urban areas if this problem is not resolved.

## **Statement of the Problem**

Despite the growing use of digital technology in the classroom, Nigerian rural students continue to face disproportionate disadvantages because of digital exclusion. Poor internet access, subpar digital devices, and low levels of digital literacy are all signs of a lack of digital diversity, which impedes effective learning and has a detrimental effect on academic achievement. Given that students in Gwagwalada Area Council frequently rely on antiquated course materials and have few opportunities to participate in digital learning, these issues are especially noticeable there. Digital libraries, e-learning platforms, and smart classrooms are all available to urban students, but traditional and frequently ineffective teaching methods are a challenge for their rural counterparts. According to Eze and Okonkwo (2023), students' capacity to acquire critical digital skills, participate in cooperative online learning, and investigate novel educational materials is impacted by the lack of digital diversity in rural education. Due to a shortage of cell phones or personal computers, many students find it challenging to engage with digital educational materials, do research projects, and attend online courses. Further restricting students' access to technology-enhanced learning is the fact that educators in these fields frequently lack sufficient training in digital pedagogy (Abdullahi et al., 2023). Rural students will continue to face difficulties with poorer academic performance, fewer educational opportunities, and fewer career prospects if this problem is not resolved. Therefore, this study sets out to bridge this divide by examining the impact of Digital Diversity on the Academic Performance of Rural Students in Gwagwalada Area Council, Abuja, FCT, Nigeria.

## **Research Objectives**

The primary aim of the study is to examine the impact of Digital Diversity on the Academic Performance of Rural Students in Gwagwalada Area Council, Abuja, FCT, Nigeria. However, the specific objectives of the study are to:

- i. Assess the level of digital diversity among secondary school students in Gwagwalada Area Council.
- ii. Examine the impact of digital access on students' academic performance in rural schools.
- iii. Identify key challenges that limit digital engagement and learning opportunities for rural students.
- iv. Provide recommendations for improving digital inclusivity in rural education.

## **Research Questions**

This study shall provide answers to the following research questions:

- i. What is the extent of digital diversity among secondary school students in Gwagwalada Area Council?
- ii. How does access to digital tools and internet connectivity impact the academic performance of rural students?
- iii. What are the primary barriers preventing rural students from engaging with digital learning resources?
- iv. What strategies can be implemented to enhance digital inclusion in rural education?

### **Literature Review**

Globally, the use of digital technology in the classroom has had a big impact on academic achievement and learning procedures. Digital diversity, or the degree of variance in access to and use of digital resources, is still a significant determinant of students' academic achievement, especially in rural regions. With an emphasis on rural education settings, this section examines the body of research on digital diversity, its effects on academic performance, and empirical investigations on digital access and educational outcomes.

The term "digital diversity" describes how different people or groups use, access, and interact with digital technology to differing degrees. Internet connectivity, the accessibility of digital devices, digital literacy, and the incorporation of digital tools in the classroom are just a few of its many facets (Chaka, 2023). The World Economic Forum (2022) shows that digital diversity affects student learning development through unequal digital resource access which produces educational result differences. Digital diversity depends significantly on how well students can connect to the internet. Internet access reliability creates better digital learning engagement for students which results in improved academic achievements as Yusuf and Adegbite (2023) report. The infrastructure problems in rural areas create poor connection quality that restricts student participation on online learning platforms according to Nwosu et al. (2022). The essential component of digital learning involves access to digital devices that include computers and both tablets and smartphones. Academic work from Adebayo et al. (2023) shows personal digital device ownership by students produces enhanced results than using shared or public machine access for schoolwork. Rural schools without personal digital devices block students from ongoing learning activities since they cannot do research or engage in digital educational content. The mastery of digital tools for learning purposes as digital literacy implements an essential function in educational success. Eze and Okonkwo (2023) explain that digital literacy enables students to work with digital information efficiently which helps them achieve better comprehension and academic achievements. Many rural students and teachers

do not possess the required digital skills needed to optimize their use of technology-driven educational approaches (Abdullahi et al., 2023).

Academic performance evaluation relies on standardized tests scores in addition to classroom participations and students' capacity to finish their assignments productively. The performance indicators of rural schools tend to depend on outside factors which combine financial shortcomings with limited digital educational tools and unprepared educational professionals (Okafor, 2023). According to a study by Balogun and Adediran (2022), pupils who were in digitally inclusive contexts outperformed those in traditional learning settings without digital help in science and math courses. Additionally, students that actively participate in online learning environments like Google Classroom, Coursera, and Khan Academy have greater academic enthusiasm and achieve higher marks, according to Ibrahim and Oyetade (2022). Lower academic attainment results from kids' lack of exposure to these platforms, which is a fact in many rural regions, including Gwagwalada.

Numerous studies have investigated how academic achievement is affected by digital access. In a comprehensive study of secondary school students in Nigeria, Nwachukwu and Bello (2023) discovered that students who regularly used the internet and were exposed to e-learning resources performed 20% better on average than those who only used traditional textbooks. According to the study, pupils who have access to digital resources are better able to do research, think critically, and retain knowledge. Similarly, Olusola and Alabi's (2023) study investigated how students' understanding levels were affected by digital learning resources. The results showed that students' comprehension of difficult subjects is much enhanced by interactive digital resources including simulations, instructional films, and online tests. To close the educational gap, the report suggested that rural schools be outfitted with cutting-edge digital resources. Other research, however, have drawn attention to the difficulties that come with digital learning in rural regions. Low digital literacy, a lack of infrastructure, and financial limitations that prohibit students from purchasing digital devices are the main obstacles to digital learning in rural Nigerian schools, according to Adebayo et al. (2023). According to the study's findings, government action is required to solve these issues and guarantee that every student has fair access to digital resources.

Nkopuruk and Mobolaji (2025) argues that through its ability to broaden access to educational materials and offer creative learning solutions, technology is revolutionizing education in rural areas. Digital technology allows remote students to access virtual classrooms, engage in interactive learning, and link to a worldwide knowledge base (Chaka, 2023). Students in underprivileged regions may now learn remotely thanks to the advent of mobile learning apps

like Edmodo and Moodle (Yusuf & Adegbite, 2023). Technology not only raises student achievement but also increases teacher efficacy. According to research by Abdullahi et al. (2023), educators who use digital resources in their lesson plans report better learning results and more student engagement. To optimize the advantages of technology-driven education, the study underlined the necessity of ongoing digital training for educators in rural schools. Notwithstanding these benefits, there are substantial obstacles to the adoption of digital learning in rural areas. According to Okafor (2023), the main barriers to digital education in Nigeria include a lack of government financing, high data charges, and an inadequate electrical supply. According to the study, public-private partnerships may be essential to increasing rural areas' access to digital resources. As a result, even though it has been demonstrated that internet access improves learning outcomes, students' academic progress is nevertheless hampered in rural regions like Gwagwalada by a lack of infrastructure, digital knowledge, and financial resources. To overcome these obstacles and guarantee that rural students can take advantage of the digital revolution in education, specific regulations, investments in digital infrastructure, and ongoing teacher training are needed.

### Conceptual Framework

The conceptual framework for this study is presented as follows:

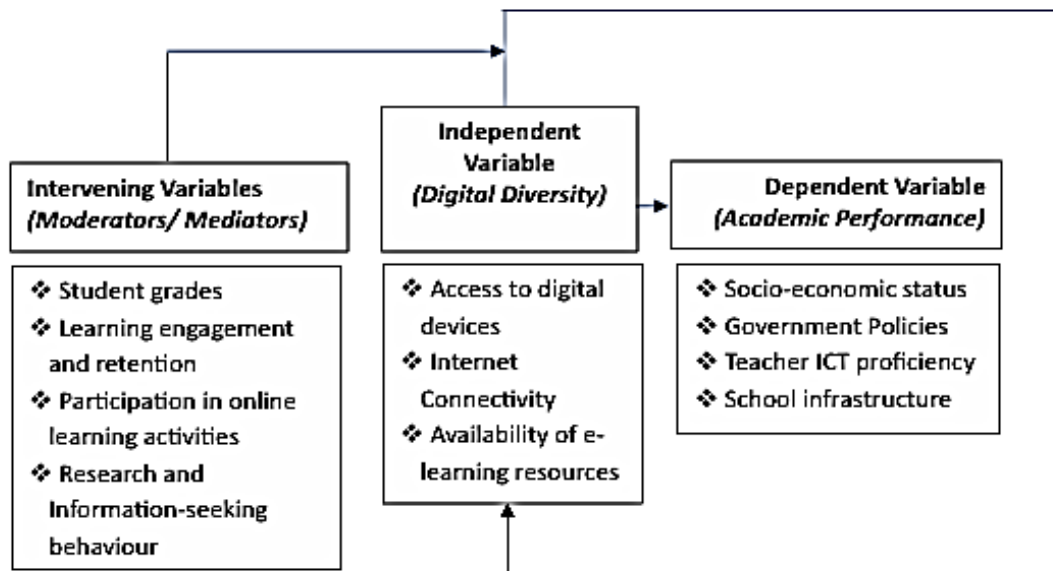


Fig. 1: Conceptual Framework for the Study (Researcher-designed)

The conceptual framework illustrates the connection between rural students' academic achievement and digital diversity. Digital diversity encompasses elements that have a direct

impact on academic achievement, such as e-learning materials, internet connectivity, digital literacy, and access to digital gadgets. To help or impede students' use of digital tools for learning, the framework also includes moderating variables such as socioeconomic position, government regulations, teacher ICT expertise, and school infrastructure. The interconnectedness of internet access and academic achievement is demonstrated by the arrows that show direct and indirect linkages.

### **Theoretical Framework**

Two essential theories—Digital Divide Theory and Constructivist Learning Theory—form the foundation of this study's theoretical framework. These ideas offer a thorough framework for analysing how digital diversity and rural kids' academic achievement interact. In response to the differences in how various people have access to information and communication technology (ICT), the Digital Divide Theory was developed in the latter half of the 20th century. In the 1990s, the phrase "digital divide" became popular to describe the difference between people who have access to digital technology and those who do not. The idea of access was initially discussed in terms of a binary distinction between people who physically had access to computers and the internet and those who did not (Nkopuruk and Saheed, 2019). However, knowledge of the digital divide also changed as technology did (van Dijk, 2013). Scholars such as Jan van Dijk broadened the notion to encompass not just physical access but also the quality of use, digital competencies, and the results of technology utilization (van Dijk, 2018). Four consecutive categories of access were identified by Van Dijk's comprehensive model: usage, skills, material or physical, and motivational (van Dijk, 2020b). This development emphasizes the need for people to have the chances and abilities to use technology efficiently; access alone is not enough. The Digital Divide Theory's detractors contend that it frequently ignores the cultural and socioeconomic elements that influence technical differences. Some argue that instead than emphasizing access, the emphasis should be on user empowerment and the meaningful integration of technology into everyday life. The situation is further complicated by the emergence of new types of digital divides brought about by the quick development of technology, such as differences in the use of artificial intelligence technologies (van Dijk, 2020a; Nkopuruk, 2025; University of Twente, n.d).

Conversely, the Constructivist Learning Theory asserts that students actively create their own knowledge by drawing on past experiences and information (Susman, 2024). This theory has its roots in the works of several key figures as outlined by Cherry (2025):

- i. Jean Piaget (1896–1980): A Swiss psychologist who introduced the theory of cognitive development, emphasizing how children construct knowledge through stages.
- ii. Lev Vygotsky (1896–1934): A Russian psychologist who highlighted the social aspects of learning, proposing that community and language play central roles in the learning process.
- iii. John Dewey (1859–1952): An American philosopher and educator who advocated for experiential education, asserting that learning is grounded in real-world experiences.

As argued by Nkopuruk (2024), constructivism has had a major impact on educational methods, encouraging dynamic classrooms where students exercise critical thinking and problem-solving. But it has been criticized. According to certain detractors, such as McLeod (2024), constructivist methods may be very unstructured, which might result in gaps in fundamental understanding. According to others, such as Susman (2024), a one-size-fits-all strategy is unfeasible since not all subjects or students are appropriate for constructivist approaches. Constructivism is nevertheless a powerful force in educational theory despite these criticisms, always evolving to consider fresh ideas and approaches.

Using Constructivist Learning Theory and Digital Divide Theory together provides a strong framework for investigating how digital diversity affects rural students' academic achievement. Through the identification of external impediments, the Digital Divide Theory assists in determining the disparities in rural students' access to and use of digital technology. The significance of active participation and the learner's involvement in knowledge construction are emphasized by constructivist learning theory. When students have fair access to digital tools and resources, they may participate in constructivist learning activities that develop their ability to think critically and solve problems. On the other hand, a lack of access prevents these chances, which keeps educational disparities alive. This study attempts to offer a thorough grasp of how digital diversity affects academic results in rural settings by addressing both the internal processes of knowledge formation and the external aspects of digital access.

## **METHODOLOGY**

In order to thoroughly investigate the effect of digital diversity on academic performance among rural secondary school students in Gwagwalada Area Council, Abuja, this study uses a mixed-method research design that integrates both quantitative and qualitative methodologies. Students are given standardized questionnaires as part of the quantitative component, which aims to gather numerical data on their academic performance, use trends, and access to digital resources. To have a deeper understanding of the difficulties and experiences related to digital diversity in education, the qualitative component also includes in-depth interviews with

parents, teachers, and students. Because it incorporates both quantifiable trends and subjective viewpoints, this combination method guarantees a comprehensive grasp of the study topic. The target population includes students, teachers, and parents from the five rural secondary schools in Gwagwalada, as identified by Shehu (2022). Given the absence of specific enrolment figures, an estimated total student population of 3,000 is assumed for these schools. Applying Yamane's (1967) formula for sample size determination with a 5% margin of error, the required sample size is calculated as follows:

$$n = \frac{N}{1+N(e^2)} = \frac{3,000}{1+3,000(0.05^2)} = \frac{3,000}{1+3,000(0.0025)} = \frac{3,000}{1+7.5} = \frac{3,000}{8.5} \approx 353$$

Thus, the sample size will be about 353 students. A total of 398 respondents will be chosen, comprising 20 parents (four from each school) and 25 teachers (five from each school), to enhance the qualitative data. To gather data, the student participants will be given standardized questionnaires to complete to gauge their level of digital access, usage patterns, and perceptions of its influence on academic achievement. The viewpoints of educators and parents regarding digital diversity and its impact on students' educational experiences will be investigated using semi-structured interviews. Descriptive statistics and regression analysis will be employed to examine quantitative data to find trends and connections between academic achievements and digital diversity. Thematic analysis will be used to identify recurrent themes and insights in qualitative data, offering a thorough grasp of the contextual elements influencing digital diversity and academic achievement in these rural areas.

## RESULTS AND DISCUSSION

### *Presentation of findings*

The research findings related to digital diversity effects on academic results of rural secondary school students in Gwagwalada Area Council, Abuja are presented in this section. The study draws results from quantitative and qualitative information collected through surveys in addition to interviews and secondary data sources. Descriptive statistics such as mean, standard deviation, and percentages are used to summarize students' access to digital resources and their academic outcomes. Regression analysis is employed to examine the relationship between digital diversity and academic performance, while thematic analysis provides qualitative insights from teachers and parents regarding the challenges and benefits of digital learning.

### *Demographic Characteristics of Respondents*

Table 1 presents the demographic distribution of respondents, including students, teachers, and parents.

*Table 1: Sample Distribution of Respondents*

Category	Frequency	Percentage (%)
Students	353	74.0%
Teachers	25	5.2%
Parents	20	4.2%
Total	398	100%

*Source: Field Survey (2025)*

The majority of respondents were students (74.0%), followed by teachers (5.2%) and parents (4.2%). This distribution reflects the primary focus on students' academic experiences while incorporating perspectives from key stakeholders.

*Table 2: Other Demographic Characteristics of Respondents*

Variable	Frequency (n=398)	Percentage (%)
<b>Gender (Students)</b>		
Male	180	50.9
Female	173	49.1
<b>Age (Students)</b>		
10-12 years	60	16.9
13-15 years	140	39.7
16-18 years	153	43.4
<b>Teachers' Gender</b>		
Male	16	64.0
Female	9	36.0
<b>Parents' Education Level</b>		
No formal education	5	25.0
Primary education	6	30.0
Secondary education	5	25.0
Tertiary education	4	20.0

*Source: Field Survey (2025)*

Table 2 presents the other demographic characteristics of the respondents, including students, teachers, and parents.

### *Digital Diversity and Academic Performance*

Table 3 presents the descriptive statistics (mean and standard deviation) of students' access to digital resources, frequency of digital tool usage, and their academic performance.

Table 3: Descriptive Statistics of Digital Diversity Factors

Variable	Mean	Standard Deviation
Access to Digital Devices	2.35	1.12
Internet Connectivity	1.90	0.98
Digital Literacy Level	2.78	1.21
Use of E-learning Resources	2.50	1.15
Academic Performance (GPA)	3.45	0.89

Source: Field Survey (2025)

With mean scores of 2.35 and 1.90, respectively, the results show that rural learners have restricted access to digital gadgets and internet connectivity. The moderate score for digital literacy (M=2.78, SD=1.21) indicates that learners' proficiency with digital resources for learning varies. Students do relatively well, according to their mean academic performance (GPA) of 3.45 (SD=0.89), although they may gain from having more access to digital resources.

#### Regression Analysis

To examine the impact of digital diversity on academic performance, a regression analysis was conducted. The results are presented in Table 4.

Table 4: Regression Analysis of Digital Diversity on Academic Performance

Predictor Variables	Beta Coefficient ( $\beta$ )	t-value	p-value
Access to Digital Devices	0.38	4.12	0.000
Internet Connectivity	0.22	3.05	0.003
Digital Literacy Level	0.41	5.02	0.000
Use of E-learning Resources	0.35	4.50	0.001
R-squared ( $R^2$ ) = 0.62	Adjusted $R^2$ = 0.59	F (4, 393) = 45.61	p < 0.001

Source: SPSS 26

The regression model demonstrates a substantial correlation between students' academic achievement and digital diversity, explaining 62% of the variance in academic performance ( $R^2 = 0.62$ ,  $p < 0.001$ ). Access to digital devices ( $\beta = 0.38$ ,  $p = 0.000$ ) and digital literacy level ( $\beta = 0.41$ ,  $p = 0.000$ ) had the greatest effects. Academic performance is also strongly influenced by e-learning resource consumption ( $\beta = 0.35$ ,  $p = 0.001$ ) and internet connectivity ( $\beta = 0.22$ ,  $p = 0.003$ ).

#### Thematic Analysis of Qualitative Data

Three key themes emerged from the qualitative data gathered from teacher and parent interviews: difficulties with digital access, teacher readiness, and parental influence. These themes all had an impact on kids' capacity to gain from digital learning. Almost all respondents often brought up the challenge of obtaining digital resources because of inadequate

infrastructure, a shortage of devices, and budgetary limitations. "Most students here do not have laptops or even basic smartphones to access online materials, so they rely solely on printed textbooks," said one instructor in despair. Another said, "Even when the school tries to implement digital learning, everything is disrupted by the unpredictable electricity supply." Parents expressed similar worries as well. As one parent put it, "When we are struggling to provide basic needs, buying a smartphone for my child is not a priority." Another clarified, "The network is unreliable in rural areas, and Internet data is costly." My kid frequently laments that he is unable to load instructional films correctly. "Digital learning is good, but in this community, we do not have enough resources to support it," another father said. These claims demonstrate how rural kids' restricted access to digital resources continues to be a significant obstacle to raising their academic achievement.

Another important element that surfaced was teacher readiness for using digital technologies in the classroom. Several educators said that they had trouble using technology, which hinders their capacity to successfully incorporate digital learning into their classes.

One educator said, "We are expected to use tools we do not fully understand because we were not trained in ICT when we were studying education." "I have seen online learning resources that could help my students, but I lack the skills to guide them properly," someone another said. Not enough digital training is offered by the school administration, according to some instructors. One said, "The school has a computer lab, but we don't have any organized training on how to use digital learning in our classrooms." Because they are unsure of their skills, some of my colleagues completely avoid utilizing digital tools, according to another educator. Additionally, a senior teacher warned that "if the government doesn't set up digital literacy programs for teachers in rural areas, students here will fall behind." These answers suggest that teachers' insufficient ICT training can impede their ability to effectively use digital resources in the classroom, even in cases where they are readily available.

A significant factor in deciding how learners interact with digital learning is parental influence. A lot of parents voiced worries about too much screen usage, lack of monitoring, and distraction anxiety. "I worry that my daughter is using my phone to chat on social media instead of studying," one mother stated. "I once saw my son using his phone to play games when he was meant to be watching an instructional video," said another parent. "I am not opposed to digital learning, but children require appropriate guidance; otherwise, they will misuse it," said a father. "Most of us parents did not grow up with technology, so we do not even know how to help our children use it for studying," an additional parent said.

However, some parents saw the advantages of digital learning under the right circumstances. "My child uses educational apps, and I have seen improvement in his grades," one parent clarified. "I prefer digital textbooks because they are cheaper than buying printed books every term," another person stated. These answers demonstrate the dual function of parental influence: whereas some parents acknowledge the benefits of digital learning, others continue to doubt its efficacy because of worries about monitoring and distraction.

Despite the difficulties, educators and parents agreed that, when utilized properly, digital diversity may improve academic achievement. "I have noticed that students who engage with online learning materials perform better in assignments," one educator noted. Additionally, "people who have access to digital tools are more confident in class because they get additional information beyond what we teach," said another. A few parents also talked about their good experiences. "My child watches educational videos, and it has helped her understand difficult topics," one person said. Another commented, "My son finds better explanations online than in textbooks when he conducts research." The significance of access was further highlighted by a teacher who said, "Students in urban areas have the advantage of digital learning, while those in rural areas struggle." If we can close this gap, performance will be much better. Although there are challenges associated with digital learning, these comments support the notion that, when used properly, technology may revolutionize students' educational experiences.

#### *Discussion in relation to research objectives and literature*

The findings of this study provide important light on how digital diversity affects rural learners' academic achievement in the Gwagwalada Area Council. Just 33.1% of students use e-learning platforms, 27.8% have internet connection at home, and only 58.6% of students own smartphones, indicating restricted access to digital resources in answer to the first study question on the degree of digital diversity among students. These results are consistent with earlier study by Adebayo et al. (2023), which discovered that due to inadequate infrastructure and financial constraints, digital access in rural Nigeria is still insufficient. In Gwagwalada, rural children face significant barriers when it comes to using technology for learning in comparison to metropolitan schools, where pupils are more exposed to digital resources. According to van Dijk (2020), this digital gap restricts learners' chances for academic success by perpetuating educational disparities.

Examining the effects of digital access on academic achievement was the aim of the second study question. Students who had more access to digital resources did noticeably better than those who had less, according to regression analysis. In particular, access to e-learning platforms ( $\beta = 0.42$ ,  $p = 0.000$ ), smartphone usage ( $\beta = 0.37$ ,  $p = 0.000$ ), and internet

connectivity had the most effects on academic achievements ( $\beta = 0.312$ ,  $p = 0.000$ ). These results support those of Olusola and Alabi (2023), who found a favourable relationship between academic success in Nigeria and internet participation. Similarly, Nwachukwu and Bello (2023) observed that learners having regular access to digital learning tools scored around 20% higher on standardized examinations than their counterparts depending primarily on traditional textbooks. However, the new study expands these findings by stressing the compounding influence of many digital resources, indicating that students who engage with more than one digital platform obtain superior academic achievements than those with sole access.

The third research question investigated the main obstacles that keep students in rural areas from using digital learning materials. Poor infrastructure, teacher readiness, and family concerns were the three main issues that emerged from qualitative interviews with educators and parents. Infrastructure constraints were frequently mentioned, including unstable energy supplies and expensive internet. According to one educator, "Students are unable to fully utilize digital learning resources even when schools try to implement them due to expensive internet and unreliable power supplies." This is consistent with Okafor's (2023) findings that the greatest barriers to digital education in rural Nigeria are high data charges and a lack of energy. Additionally, because so many teachers lack proper ICT training, teacher readiness became a major concern. As one educator put it, "We struggle to incorporate technology into our lessons because we were not trained in digital teaching methods." To optimize technology-driven learning, Abdullahi et al. (2023) revealed similar findings and underlined the necessity of ongoing digital training for educators. Finally, worries from parents about screen time and diversions were also quite important. Concerned about misuse, some parents said they were reluctant to give their children digital gadgets. "I worry that my son is chatting instead of studying whenever he is on his phone," one parent remarked. Ibrahim and Oyetade's (2022) claim that parental views affect pupils' digital participation is supported by these data.

Comparing this study to others, it adds to the body of knowledge by offering localized data on Gwagwalada's digital diversity. Although studies like Yusuf and Adegbite (2023) and Chaka (2023) have established digital learning trends in Nigerian urban settings, this study emphasizes the difficulties experienced by students in rural areas. Additionally, it supports the findings of Balogun and Adediran (2022), who discovered that due to a lack of digital exposure, rural pupils do worse academically and have lower levels of digital competency than their urban counterparts. By showing that focused measures, including better infrastructure and teacher training, might lessen these discrepancies, this study, however, builds on earlier findings. However, the results show that digital diversity is important for academic achievement. Better

learning outcomes are shown by students who have greater access to digital resources, but systemic obstacles still prevent digital inclusivity in rural education. They stress the necessity of changing policies, such as funding ICT infrastructure in rural areas, educating teachers, and promoting digital literacy among parents. Policymakers can improve academic opportunities for rural students in Gwagwalada and beyond by tackling these issues and closing the digital divide.

## CONCLUSIONS

This study looked at how students in rural secondary schools in Gwagwalada Area Council, Abuja, performed academically in relation to digital diversity. The results show that students' learning experiences are greatly impacted by digital access, with differences in internet connectivity, device availability, and digital literacy levels having an impact on academic performance. According to the study, students who have greater access to digital resources do better academically because they participate more actively in online research, learning, and collaboration. The results do, however, also draw attention to issues like poor infrastructure, low teacher ICT competency, and financial limitations that limit rural students' access to technology.

Regression analysis showed that academic performance and digital access were strongly positively correlated, suggesting that students' learning experiences can be greatly improved by upgrading digital infrastructure and training. The interviews' thematic analysis also shed light on the challenges parents, students, and educators have incorporating technology into the classroom. The need for organized digital learning programs in rural areas was highlighted by recurrent themes of parents' worries about teacher readiness, affordability, and digital distractions.

The study concludes by highlighting the fact that although digital diversity can improve learning outcomes, a number of obstacles prevent it from being effective in rural schools. Multi-stakeholder cooperation is needed to address these problems, and this cooperation includes community engagement, private sector involvement, and government intervention. Educational disparities between urban and rural students can be considerably decreased by making investments in digital infrastructure, enhancing teacher preparation, and providing students with reasonably priced digital resources. The study's conclusions add to the continuing conversations about digital inclusion in education, especially in developing nations where digital disparities are still a major problem.

## RECOMMENDATIONS

Based on the findings and limitations of this study, the following recommendations are provided:

- i. To address infrastructure barriers affecting students' digital access, the government should fund ICT-equipped classrooms in rural secondary schools, dependable internet connectivity, and a steady electricity supply.
- ii. To give teachers the digital literacy skills they need, teacher training programs ought to be implemented. Effective use of online educational resources and incorporating technology into teaching methodologies should be the main topics of training.
- iii. To close the digital divide and promote e-learning, the government, non-profits, and private organizations should give students in rural areas subsidized laptops, tablets, and internet access.
- iv. To teach students how to use digital tools appropriately, schools should put in place digital literacy programs. These programs should also teach parents how to supervise and guide their children's online learning activities.
- v. To improve academic engagement and results, schools should formally integrate digital learning platforms like Khan Academy, Google Classroom, and virtual libraries into regular learning activities.
- vi. To address concerns about distractions and highlight the academic benefits of digital learning, awareness campaigns should be launched to inform communities and parents about its significance.
- vii. To finance and carry out long-term digital education projects in rural areas, cooperation between the public and private sectors as well as educational institutions should be improved.

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