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BRIDGING THE DIGITAL DIVIDE: EQUITY AND ACCESS TO TECHNOLOGY-ENHANCED LEARNING IN RURAL COMMUNITIES

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Abstract

This study examined equity and access to technology-enhanced learning in rural communities in Rivers State, Nigeria. The study adopted a descriptive survey design. The population comprised all teachers and students in public secondary schools in rural areas of Rivers State. A sample of 400 respondents was selected using multi-stage sampling technique. Data were collected using a structured questionnaire titled "Equity and Access to Technology-Enhanced Learning Questionnaire" and interview schedule. The instrument was validated by experts and had a reliability coefficient of 0.82 using Cronbach Alpha. Mean, standard deviation, Pearson Product Moment Correlation and Simple Linear Regression were used to answer research questions and test hypotheses at 0.05 level of significance. Findings revealed that the extent of access to digital infrastructure, devices and internet connectivity in rural schools is low. The study also found that digital competence among teachers and learners significantly influences the effective use of technology-enhanced learning. It was concluded that inadequate infrastructure and limited digital competence are major barriers to equity in technology-enhanced learning in rural communities. The study recommended provision of ICT facilities, alternative power supply, regular teacher training, and stakeholder collaboration to bridge the digital divide.

Keywords: Equity, Access, Technology-Enhanced Learning, Digital Infrastructure, Rural Communities

Introduction

The rapid diffusion of digital technologies in the 21st century has fundamentally altered how knowledge is produced, distributed, and consumed. Across the globe, education systems are increasingly mediated by digital tools such as learning management systems, mobile applications, virtual laboratories, artificial intelligence tutors, and broadband-enabled classrooms. This shift toward technology-enhanced learning has been widely celebrated for its potential to personalize instruction, expand access to high-quality content and prepare learners for a digital economy. International organizations and national governments have invested heavily in digital education infrastructure with the expectation that technology will serve as a great equalizer, closing long-standing gaps in educational opportunity. However, the promise of technology-enhanced learning remains unevenly realized. While urban centers and well-resourced institutions have rapidly integrated digital tools into teaching and learning, rural communities continue to experience systemic exclusion from these innovations. This disparity is commonly referred to as the "digital divide" and it represents one of the most pressing equity challenges facing education today.

The concept of the digital divide initially referred to the gap between those who had access to computers and the internet and those who did not. Early scholarship focused primarily on physical access to hardware and connectivity. Over time, researchers recognized that the divide is multidimensional. It encompasses not only first-level access to devices and internet, but also second-level divides related to digital skills and third-level divides related to the ability to translate digital engagement into tangible educational and economic outcomes. Ayere, Odera &Agak (2010) stated that in the context of education, the divide manifests as differences in the availability of broadband, the presence of digital devices in schools and homes, the preparedness of teachers to use technology pedagogically, the relevance of digital content to local contexts, and the support structures that enable sustained use. In rural communities, these dimensions intersect and reinforce one another, producing a cumulative disadvantage that limits learners' ability to benefit from technology-enhanced learning (UNESCO, 2020).

Rural communities occupy a unique position within national education systems. They are often characterized by lower population density, geographic isolation, limited public infrastructure, and economies that rely heavily on agriculture and informal labor. These structural conditions create distinct barriers to the deployment and sustainability of educational technology. In the words of Lambert (2024), broadband penetration remains significantly lower in rural areas compared to urban areas in most countries, including in Sub-Saharan Africa, South Asia and parts of Latin America and North America. Even where connectivity exists, it is frequently unreliable, expensive, and insufficient for bandwidth-intensive learning activities such as video streaming or cloud-based collaboration. Beyond infrastructure, rural schools often face shortages of qualified teachers, limited technical support personnel and constrained budgets that make it difficult to procure,

maintain, and update digital devices. Homes in rural areas may lack electricity, let alone devices or data plans, placing the burden of access entirely on schools that are themselves under-resourced.

The consequences of this divide extend beyond the classroom. Obizue & Obizue (2025) posited that education is a primary mechanism through which individuals acquire the competencies needed for participation in a digital society and economy. When rural learners are excluded from technology-enhanced learning, they are also excluded from developing digital literacy, computational thinking and online collaboration skills that are increasingly required for higher education and employment. This exclusion reproduces and deepens existing inequalities. Learners in rural communities may graduate with the same formal credentials as their urban peers, but without comparable digital capabilities, their transition to postsecondary education or the labor market is disadvantaged (Abioye & Idowu, 2023). Over time, this contributes to rural-urban migration, brain drain and the persistent underdevelopment of rural economies. Thus, the digital divide in education is not simply a technical problem to be solved with more devices; it is a social and economic problem with long-term implications for equity and national development.

Global and national policy responses have acknowledged the urgency of this issue. The United Nations Sustainable Development Goal 4 calls for inclusive and equitable quality education and the promotion of lifelong learning opportunities for all, with explicit attention to vulnerable populations. The COVID-19 pandemic further exposed and intensified the digital divide, as school closures forced a rapid shift to remote and online learning. During this period, learners in well-connected urban households were able to continue instruction with relative continuity, while many rural learners experienced prolonged learning loss due to lack of access. This experience prompted renewed commitments from governments and development partners to expand rural connectivity, provide devices and train teachers. Yet evidence suggests that simply distributing technology without addressing the broader ecosystem of support often yields limited results. Access without relevance, training, and maintenance does not translate into meaningful learning.

In Nigeria and many other developing contexts, the challenge is particularly acute. Nigeria's National Policy on Education emphasizes the integration of information and communication technology into teaching and learning at all levels. Initiatives such as the School Connectivity Program and various state-level e-learning projects aim to bring digital tools to schools. However, implementation in rural areas has been hampered by erratic power supply, limited internet backbone and low teacher digital competence. Rural communities in Nigeria also contend with linguistic and cultural diversity that requires localized digital content, which is often absent. Furthermore, socio-economic factors such as poverty and gender norms can restrict who within a household or community gets to use available technology. As a result, technology-enhanced learning risks becoming another mechanism through which existing inequalities are reproduced unless deliberate equity-focused strategies are adopted.

Equity in this context means more than equal distribution of resources. It requires attention to the differential needs of rural learners and the design of interventions that account for context. This includes affordable and resilient connectivity solutions such as community networks or offline digital libraries, devices that are appropriate for local conditions, teacher professional development that is ongoing and context-specific, and digital content that reflects rural livelihoods, languages, and aspirations. It also requires the involvement of community stakeholders in planning and governance, so that technology adoption is not imposed from outside but owned locally. Research from community-based technology projects indicates that when rural communities are engaged as partners rather than passive recipients, adoption rates increase and technologies are more likely to be sustained.

Despite growing recognition of these issues, there remains a gap in empirical research that examines how equity and access to technology-enhanced learning can be effectively bridged in rural communities, particularly in low-resource settings. Much of the existing literature is either descriptive, focusing on documenting the extent of the divide, or prescriptive, offering technical solutions without grounding in local realities. Few studies take a holistic approach that considers infrastructure, human capacity, content, policy, and community engagement together. This study seeks to address that gap by exploring the barriers to and enablers of equitable access to technology-enhanced learning in rural communities, with the aim of generating evidence that can inform policy and practice.

Understanding how to bridge the digital divide in rural education is not only a matter of social justice but also of economic necessity. As digital technologies become more central to agriculture, health, governance, and commerce, rural populations that are digitally excluded will be unable to participate fully in national development. Conversely, when rural learners gain equitable access to technology-enhanced learning, they are better positioned to innovate within their communities, access broader markets and information, and contribute to diverse economic sectors. Therefore, bridging the digital divide is both an educational imperative and a development strategy. DFGHHJ (900) noted that substantial investments have been made in educational technology yet rural communities continue to lag behind in access to and meaningful use of digital learning tools. Learners in these communities face intersecting barriers related to infrastructure, affordability, teacher capacity, and content relevance, which limit their ability to benefit from technology-enhanced learning. As a result, the digital divide persists and in some cases widens, undermining efforts to achieve educational equity and inclusive economic development. There is a need for research that moves beyond documenting the divide to identifying contextually appropriate strategies for bridging it in rural settings.

The findings of this study will be significant to policymakers, educational planners and development partners working to expand digital education in rural areas. By providing empirical

evidence on barriers and enablers, the study will inform the design of more equitable and sustainable technology interventions. For rural communities, the study offers a pathway for leveraging technology to improve learning outcomes and economic opportunities. For the academic community, it contributes to the literature on digital equity by centering rural contexts that are often underrepresented.

The main purpose of this study is to evaluate the state of equity and access to technology-enhanced learning in rural communities and to identify strategies for bridging the digital divide.

The specific objectives of this study are:

1. To examine the extent of access to digital infrastructure, devices and internet connectivity for technology-enhanced learning in rural communities.

2. To assess the level of digital competence among teachers and learners and its influence on the effective use of technology-enhanced learning in rural communities.

In line with the objectives, the study seeks to answer the following questions:

1. To what extent do rural communities have access to digital infrastructure, devices and internet connectivity for technology-enhanced learning?

2. To what extent does the level of digital competence among teachers and learners influence the effective use of technology-enhanced learning in rural communities?

The following null hypotheses will be tested at 0.05 level of significance:

H01: There is no significant extent of access to digital infrastructure, devices and internet connectivity for technology-enhanced learning in rural communities.

H02: There is no significant influence of digital competence among teachers and learners on the effective use of technology-enhanced learning in rural communities.

Concepts

Digital Device

A digital device refers to any electronic equipment that processes, stores, and transmits information in digital form using binary code of 0s and 1s. Unlike analog devices that operate on continuous signals, digital devices convert data into discrete numerical values, which allows for faster processing, higher accuracy, and easier storage and retrieval of information. In the context of education, digital devices have become central tools for technology-enhanced learning because they serve as the medium through which learners access digital content, interact with learning platforms and develop 21st century skills. Oyendu (2022) observed that common examples in

educational settings include desktop computers, laptops, tablets, smartphones, interactive whiteboards, projectors and e-readers. These devices function by integrating hardware components such as processors, memory and input-output systems with software applications that enable teaching and learning activities such as simulations, video conferencing, collaborative documents and adaptive assessments.

The relevance of digital devices in education extends beyond mere access to information. They provide opportunities for personalized learning, immediate feedback and the development of digital literacy, which is increasingly recognized as a core competency for participation in the modern economy (Obizue & Obizue, 2025). However, the effectiveness of digital devices in learning is dependent on factors such as availability, affordability, reliability of power supply and the digital competence of both teachers and learners. In rural communities, limited access to these devices continues to widen the digital divide and restricts learners' ability to benefit from technology-enhanced instruction. Therefore, equitable distribution and sustainable use of digital devices remain critical for bridging educational inequalities and ensuring that all learners, regardless of location, can participate meaningfully in a digital learning environment.

Technology-Enhanced Learning

Technology-Enhanced Learning, often abbreviated as TEL, refers to the use of digital technologies to support, enrich and transform teaching and learning processes. Nzeocha (2018) stated that it goes beyond the mere digitization of traditional instructional materials by integrating tools such as computers, mobile devices, learning management systems, educational software, virtual simulations and internet resources into pedagogy to create more interactive, flexible, and learner-centered experiences. The core idea of TEL is not that technology replaces the teacher, but that it serves as a mediator that expands access to knowledge, enables personalized learning pathways and facilitates collaboration beyond the physical classroom. Through TEL, learners can engage with multimedia content, receive immediate feedback, participate in virtual laboratories, and connect with peers and experts across geographical boundaries, thereby making learning more contextual and relevant to real-world problems.

The significance of TEL lies in its potential to address issues of equity, quality and scalability in education. When properly implemented, it can provide rural and underserved learners with access to quality content and expert instruction that may not be available locally, while also supporting teachers with resources for professional development and instructional design. However, the impact of TEL is contingent on factors such as reliable infrastructure, digital competence of educators and learners, and the relevance of digital content to local contexts. Without these enabling conditions, technology risks becoming an additional barrier rather than a bridge (kaka, 2021). Thus, technology-enhanced learning is best understood as a pedagogical approach in which

technology is intentionally aligned with learning objectives to improve educational outcomes and prepare learners for participation in a digital society.

Theoretical Framework

The Digital Divide Theory

This theory was advanced by Jan van Dijk who conceptualized the digital divide not as a single gap in access to computers and the internet, but as a process with four successive stages of inequality. The first is motivational access, which concerns the desire to use digital technologies. The second is material access, which refers to the actual possession of computers, internet connectivity and other devices. The third is skills access, which involves both operational skills to use hardware and software and informational skills to search, evaluate and apply digital information. The fourth is usage access, which relates to the amount and diversity of time spent using digital technologies and the ability to translate that use into tangible benefits. According to this theory, inequalities in earlier stages compound and lead to greater disadvantages in later stages. In the context of this study on bridging the digital divide in rural communities, the theory is highly relevant because it provides a multidimensional lens for examining why rural learners and teachers may be excluded from technology-enhanced learning. It moves the discussion beyond simply counting devices to understanding issues of motivation, infrastructure, teacher training and meaningful application. By applying Van Dijk (2020) framework, the study can identify at which stage the greatest barriers exist in rural schools and therefore recommend targeted interventions that address not only material provision but also capacity building and contextual use.

Technology Acceptance Model

The second theory relevant to this study is the developed by Fred Davis. The Technology Acceptance Model posits that the actual use of a technology is primarily determined by two key beliefs: perceived usefulness and perceived ease of use. Perceived usefulness refers to the degree to which a person believes that using a particular technology will enhance their performance, while perceived ease of use refers to the degree to which a person believes that using the technology will be free of effort. These beliefs are shaped by external variables such as training, support and system characteristics and they in turn influence attitude toward use, behavioral intention and ultimately actual usage. In relation to this study, the model is important because the successful integration of technology-enhanced learning in rural communities depends not only on the availability of devices and connectivity, but also on whether teachers and learners believe that these technologies are useful for improving teaching and learning and whether they feel capable of using them without major difficulty. In many rural settings, resistance or low uptake of digital tools is often linked to low confidence, lack of training and doubt about relevance to local curriculum needs. Obizue & Obizue (2025) emphasized that by using the Technology Acceptance Model, this study can explore

how perceptions and competence influence the adoption and sustained use of digital tools in rural schools. The model thus complements the Digital Divide Theory by explaining the human and attitudinal factors that determine whether access translates into effective educational practice.

Empirical Review

The empirical literature reviewed reveals consistent evidence that equity and access to technology-enhanced learning remain major challenges in rural communities and that the digital divide is shaped by multiple interrelated factors. Across different contexts, studies show that rural schools consistently lag behind urban schools in terms of infrastructure, device availability and internet connectivity and that these material gaps directly limit the capacity of teachers and learners to engage meaningfully with digital tools.

Abioye & Idowu (2023) examined the COVID-19 period and found that both device availability and teacher digital competence significantly influenced students' engagement in online learning in rural schools. Regression analysis showed that teacher competence was the strongest predictor of student engagement. The study also revealed that students without electricity or smartphones experienced severe learning loss. The researchers recommended investments in rural electrification, affordable data, and teacher training.

Kaka (2021) studied the human and institutional dimensions of technology integration. Using a mixed-methods approach, they found that rural teachers had low confidence in using ICT and limited professional development opportunities. However, where school leaders actively supported ICT use, teachers were more likely to integrate technology despite infrastructural challenges. The study argued that both supply-side factors like devices and demand-side factors like teacher competence and leadership are essential for effective ICT use. This supports the present study's inclusion of digital competence and institutional support as key variables.

Oye, N. D., Salleh, M. & Iahad, N. A. (2012) examined E-learning in Nigerian tertiary institutions: Status and prospects. The study showed that while e-learning can improve academic performance, its benefits are not equally distributed. Their quasi-experimental study found that urban students with reliable internet and personal devices outperformed rural students in a blended learning environment. Rural students faced barriers such as poor network coverage, high data costs, and low digital literacy, which reduced their engagement with online platforms. The study concluded that access must be accompanied by affordability and skills for technology-enhanced learning to be effective. This finding is relevant to this current study because it highlights that bridging the digital divide requires more than device provision.

Finally, Ayere, Odera & Agak's (2010) study in Kenya demonstrated that rural secondary schools had significantly lower access to computers and internet compared to urban schools. The

researchers found that only a small proportion of rural teachers used ICT regularly for instruction due to poor infrastructure, irregular electricity and lack of training. The study concluded that without targeted policy support for rural schools, disparities in technology use would continue to grow. This aligns with the focus of the present study on how material access forms the foundation for technology-enhanced learning in rural areas.

In summary, the reviewed studies collectively indicate that bridging the digital divide in rural education requires an integrated approach. Access to infrastructure and devices is necessary but not sufficient. Teacher competence, leadership support, affordability and relevant content are equally important in ensuring that technology-enhanced learning leads to equitable educational outcomes. These findings provide the empirical basis for the present study on equity and access to technology-enhanced learning in rural communities in Rivers State.

Methods

This study adopted a descriptive survey research design to evaluate equity and access to technology-enhanced learning in rural communities. A descriptive survey design was considered appropriate because it allows for the systematic collection of data from a large population in order to describe, explain and interpret the current status of a phenomenon without manipulating variables. The design also provides the opportunity to gather both quantitative and qualitative data, which is necessary for understanding the multidimensional nature of the digital divide in education. The study was carried out in selected rural communities across three senatorial districts in Rivers State, Nigeria. Rivers State was chosen because it contains a mix of riverine and upland rural communities with varying levels of infrastructure development, making it suitable for examining differences in technology access and use. Within the state, six rural Local Government Areas with documented low internet penetration and limited school digital resources were purposively selected as case study sites. The case study approach enabled an in-depth exploration of how contextual factors such as geography, power supply, and community support influence technology-enhanced learning in rural settings. The total population for the study comprised all public secondary school teachers and senior secondary students in the selected rural LGAs. According to the Rivers State Senior Secondary Schools Board 2025 records, the six LGAs have a total of 142 public secondary schools with an estimated population of 1,240 teachers and 18,650 students, giving a combined population of 19,890. From this population, a sample size of 400 respondents were determined using the Taro Yamane formula at 95% confidence level and 5% margin of error. A multi-stage sampling technique was employed to select participants. In the first stage, the six LGAs were purposively selected based on rurality and low digital infrastructure. In the second stage, two schools were randomly selected from each LGA using simple random sampling, giving a total of 12 schools. In the third stage, proportionate stratified random sampling was used to select 200 teachers and 200 students across the 12 schools, ensuring fair representation

by gender and school size. This sampling approach was adopted to ensure that the sample was both representative and manageable for data collection within the rural context. The study utilized both primary and secondary data. Primary data were collected through a structured questionnaire and a semi-structured interview guide. The questionnaire titled Equity and Access to Technology-Enhanced Learning Questionnaire, (EATELQ) was divided into four sections. Section A elicited demographic information while Sections B to D contained 25 items on a 4-point Likert scale measuring access to infrastructure, digital competence and content relevance. The interview guide was used to collect qualitative insights from 12 school principals and 6 community leaders on barriers and enablers to technology use. Secondary data were sourced from government policy documents, school records and reports from the Universal Service Provision Fund. The instruments were validated using face and content validity. Three experts, respectively in Educational Administration, Technology and Measurement and Evaluation from the University of Port Harcourt reviewed the instruments for clarity, relevance and coverage. Their corrections and suggestions were incorporated into the final draft. The reliability was established by conducting a pilot test with 30 teachers and 30 students from two rural schools outside the study area. Data from the pilot were analyzed using Cronbach's Alpha and a reliability coefficient of 0.84 was obtained for the questionnaire, which was reasonably high and acceptable for the study.

Data collection was carried out over a period of four weeks with the help of six trained research assistants. Copies of the questionnaire were administered directly to teachers and students in their schools and retrieved on the spot to ensure a high return rate. Out of 400 questionnaires administered, 384 were retrieved and found usable, representing a 96% return rate. Interviews were conducted face-to-face and audio-recorded with permission, after which they were transcribed verbatim. Quantitative data obtained from the questionnaire were coded and analyzed using descriptive statistics such as mean and standard deviation to answer research questions, while inferential statistics of Pearson Product Moment Correlation and simple regression were used to test the hypotheses at 0.05 level of significance with the aid of SPSS version 26. For the Likert items, a criterion mean of 2.50 was adopted as the decision rule, such that any item with a mean score of 2.50 and above was regarded as agreed while items below 2.50 was regarded as disagreed. Qualitative data from interviews were analyzed thematically to identify recurring patterns and to complement the quantitative findings. All ethical considerations including informed consent, voluntary participation and confidentiality were strictly observed throughout the study.

Results and Analysis

Results of Research Questions

Research Question One sought to determine the extent of access to digital infrastructure, devices, and internet connectivity for technology-enhanced learning in rural communities. The responses were analyzed using mean and standard deviation with a criterion mean of 2.50.

Table 1: Extent of Access to Digital Infrastructure and Devices for Technology-Enhanced Learning

S/N	Item Statement	N	Mean	SD	Decision
1	My school has functional computers for teaching and learning	384	2.18	0.92	Low Extent
2	Students have access to internet connectivity in school	384	2.01	0.88	Low Extent
3	There is stable electricity to power digital devices in school	384	2.34	0.95	Low Extent
4	Teachers have access to laptops/tablets for instructional purposes	384	2.27	0.90	Low Extent
5	The school has a functional ICT laboratory	384	2.12	0.97	Low Extent
Cluster Mean		2.18	0.92		Low Extent

The data in Table 1 show that all items had mean scores below the criterion mean of 2.50, with a cluster mean of 2.18 and standard deviation of 0.92. This indicates that the extent of access to digital infrastructure, devices and internet connectivity in the sampled rural schools is low. The lowest mean was recorded for internet connectivity, suggesting that poor network access is the most critical barrier. During interviews, principals confirmed that most schools rely on personal mobile data and that power outages frequently disrupt any available digital activities.

Research Question Two dealt with the extent to which digital competence among teachers and learners influences the effective use of technology-enhanced learning in rural communities.

Table 2: Influence of Digital Competence on Effective Use of Technology-Enhanced Learning

S/N	Item Statement	N	Mean	SD	Decision
1	Teachers can operate basic computer applications for teaching	384	2.68	0.85	High Extent
2	Teachers can use the internet to source educational materials	384	2.71	0.81	High Extent
3	Students can use digital devices to complete assignments	384	2.56	0.89	High Extent
4	Teachers are able to integrate technology into lesson delivery	384	2.42	0.93	Low Extent
5	Students and teachers receive regular training on digital skills	384	2.21	0.96	Low Extent
	Cluster Mean	2.52	0.89		High Extent

Table 2 shows a cluster mean of 2.52, which is slightly above the criterion mean. This implies that digital competence among teachers and learners is at a moderate to high extent and has some influence on the use of technology-enhanced learning. However, the low means on items relating to integration into lessons and regular training indicate that while basic operational skills exist, pedagogical application and continuous capacity building are lacking. Interview data revealed that most teachers learned basic ICT skills informally and have not received formal in-service training in the last two years.

Test of Hypotheses

The two null hypotheses were tested at 0.05 level of significance using Pearson Product Moment Correlation and Simple Linear Regression with SPSS version 26.

Hypothesis One: There is no significant extent of access to digital infrastructure, devices and internet connectivity for technology-enhanced learning in rural communities.

Table 3: Correlation between Access to Infrastructure and Use of Technology-Enhanced Learning

Variables	N	r	r²	p-value	Decision
Access to Infrastructure	384	.612	.375	.000	Significant
Use of TEL	384				

The result in Table 3 shows a Pearson correlation coefficient of r = .612, p = .000. Since the p-value is less than 0.05, the null hypothesis is rejected. This means there is a significant positive relationship between access to digital infrastructure, devices and internet connectivity and the use of technology-enhanced learning in rural communities. The r² value of .375 indicates that 37.5% of the variation in the use of TEL can be explained by access to infrastructure. The finding suggests that improving infrastructure will lead to a substantial increase in technology use.

Hypothesis Two: There is no significant influence of digital competence among teachers and learners on the effective use of technology-enhanced learning in rural communities.

Table 4: Regression Analysis of Digital Competence and Effective Use of TEL

Model	R	R²	Adjusted R²	F	p-value	Decision
1	.548	.300	.298	163.42	.000	Significant

Table 4 presents the regression result with R = .548 and R² = .300. The F-value of 163.42 with p value of .000 is significant at 0.05 level. Therefore, the null hypothesis is rejected. This implies that digital competence among teachers and learners has a significant influence on the effective use of technology-enhanced learning in rural communities. The R² value shows that digital competence accounts for 30% of the variance in effective use of TEL. The interview responses further supported this, as schools with teachers who had attended even short ICT workshops reported more consistent use of digital tools despite infrastructural limitations.

Discussion of Finding

The findings of this study reveal that rural secondary schools in Rivers State have low access to digital infrastructure, devices, and internet connectivity. The cluster mean of 2.18 confirms that issues such as lack of functional computers, poor internet and unstable power remain major barriers. This aligns with Ayere, Odera & Agak (2010) who reported similar infrastructural deficits in rural Kenyan schools and concluded that material access is a prerequisite for technology

integration. It also agrees with Abioye & Idowu (2023) who found that lack of electricity and devices led to learning loss during the pandemic.

On digital competence, the study found a moderate to high level of basic skills but low pedagogical integration and training. The significant influence of digital competence on effective use of TEL, accounting for 30% of variance, supports the Technology Acceptance Model which posits that perceived ability and ease of use determine actual technology adoption. This is consistent with Kaka (2021) who noted that teacher confidence and training were critical in South African rural schools.

The significant relationship between infrastructure access and TEL use confirms the Digital Divide Theory by Van Dijk (2020), which argues that material access is the first stage that determines later stages of skills and usage. Without resolving infrastructure gaps, efforts to build competence will yield limited results.

Conclusion

This study concludes that equity and access to technology-enhanced learning in rural communities in Rivers State remain significantly constrained by inadequate digital infrastructure and limited institutional support. Findings revealed that the extent of access to computers, internet connectivity and stable power in rural schools is low and this has a significant relationship with the use of technology-enhanced learning. While teachers and learners possess moderate basic digital competence, the lack of regular training and pedagogical integration limits the effective use of digital tools in instruction. The study therefore affirms that bridging the digital divide in rural education requires simultaneous investment in material resources and human capacity. Without addressing both infrastructure and digital competence, efforts to promote technology-enhanced learning in rural areas will continue to yield minimal impact on educational equity and quality.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. The government of Rivers State in collaboration with the Ministry of Education and NITDA should ensure the provision of functional ICT facilities such as computers, tablets, projectors, and reliable internet connectivity in all rural secondary schools to support technology-enhanced learning.

2. Rural schools should be equipped with alternative and sustainable power sources such as solar energy systems to address the problem of irregular electricity and ensure uninterrupted use of digital devices for teaching and learning.

3. Regular and continuous professional development programmes should be organized for teachers to improve their digital competence and pedagogical skills in integrating technology into classroom instruction.

4. School administrators should create a supportive environment by including ICT-based lessons on the school timetable, providing technical support, and encouraging teachers to use digital tools for teaching.

5. Government, private organizations and community stakeholders should collaborate to provide affordable digital devices and subsidized data plans for students in rural areas to reduce cost barriers and promote equity in access to technology-enhanced learning.

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