
**ASSESSMENT OF THE ROLES OF DIGITAL INNOVATIVE PRACTICES ON
SUSTAINABLE LEARNING IN SECONDARY SCHOOLS IN RURAL AREAS OF
ANAMBRA STATE**

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Abstract

This study will assess the roles of digital innovative practices on sustainable learning in secondary schools in rural areas of Anambra State. The study will be guided by three research questions. The study will employ a descriptive survey research design. The population will consist of 51,444 students enrolled in public secondary schools in Anambra State. Taro Yamene's formula will be used to determine a sample size of 397. The instrument for data collection will be a self-developed questionnaire organized into four clusters, each addressing one research question. Each cluster will have eight (8) items, thereby making it a total of 24 questionnaire items. The instrument will use a 4-point rating scale: Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1). Three research experts will validate the instrument, while its internal consistency will be determined using

Cronbach's Alpha based on a trial test involving 20 students in public secondary schools in Enugu State. Mean and standard deviation will be used to analyze data related to the research questions.

Keywords: Innovation, Digital Innovation, Sustainable Learning, Digital Innovation Practices

Introduction

Secondary schools play a fundamental role in national development because they serve as the bridge between basic and higher education, providing learners with the cognitive, affective and psychomotor foundations required for advanced academic pursuits (Kumar, et. al., 2021). These schools function as institutions where adolescents refine their skills, attitudes and values needed for productive citizenship and workforce readiness. Their effectiveness is therefore essential in shaping human capital development and societal progress. As these institutions continue to expand across regions, their operational quality becomes more crucial. Consequently, understanding their capacity to foster long-term academic growth becomes vital, especially regarding sustainable learning in secondary schools.

Secondary schools, irrespective of their geographical location, play similar developmental functions, making their relevance universal whether situated in urban or rural communities (Velempini, 2022). Urban schools may have better infrastructure, yet rural schools equally prepare learners for societal contributions, demonstrating the shared mandate of equitable education provision. Each school environment contributes uniquely to enriching students' experiences and strengthening national educational outcomes. Therefore, ensuring efficient teaching and learning becomes a shared priority across all locations. This recognition reinforces the growing concern that sustainable learning must be promoted consistently in rural secondary schools to enhance long-term academic progress.

Sustainable learning is defined as a continuous educational process that enables learners to acquire, apply and retain knowledge in ways that support lifelong development and community transformation (Ben-Eliyahu, 2021). This definition emphasizes learning that endures beyond examinations and encourages adaptability in changing environments. Another definition describes sustainable learning as an instructional approach that integrates relevance, reflection and resilience into the learning process to ensure that knowledge remains useful over time (Chen, 2019). This perspective highlights the importance of meaningful learning experiences that empower students to think critically and apply skills in real-world contexts. Both definitions underline learning processes that support lasting academic and societal outcomes.

The importance of sustainable learning has continued to increase globally, especially in rural communities where educational disadvantages are more pronounced (UNESCO, 2023). In developed countries such as Finland, rural schools has implemented widespread digitalisation in its schools including digital textbooks, ICT infrastructure and increasing access to digital learning resources in urban and rural areas (Näykki & Häkkinen, 2023). Similarly, Canada records a 40% increase in learner engagement in remote areas due to sustained learning frameworks. Across Africa, Rwanda's rural schools experienced a 28% improvement in science learning outcomes after adopting community-based sustainable learning initiatives (Whitley, et. al., 2021). These examples show that sustainable learning enhances equity, reduces educational gaps and strengthens long-term academic achievements in rural areas.

Sustainable learning is particularly important in the rural areas of Anambra State, where students often face barriers such as limited learning resources, infrastructural constraints and inadequate teacher deployment. Access to stable learning practices ensures that students in areas like Awka North, Orumba North, Dunukofia and Anambra West benefit from improved retention and consistent academic progress. Recent state education monitoring reports indicate that rural schools with structured learning continuity recorded an improvement in junior secondary academic performance (Okeke, 2024). These outcomes demonstrate that sustainable learning contributes significantly to reducing educational disparities between urban and rural schools and strengthening overall student achievement in Anambra State.

Poor sustainable learning in rural areas poses numerous dangers, especially within Anambra State where learning interruptions remain common (Ogbudinkpa, 2021). Rural students frequently experience declining academic achievement, reduced interest in schooling and weakened foundational competencies when learning is not sustained. These deficiencies often translate into lower transition rates to senior secondary and tertiary education levels. The long-term implications include increased dropout rates, widened urban-rural educational inequalities and weakened community development prospects. Furthermore, inadequate sustainable learning reduces students' readiness for science, technology and digital-related subjects, thereby limiting their future employability. These concerns highlight the urgency of addressing the persistent barriers undermining sustainable learning in rural Anambra State.

The persistence of these problems in Anambra State can be traced to inadequate infrastructure, insufficient teacher capacity and limited exposure to modern educational technologies in rural communities (Umeji, 2024). Many schools lack digital tools, functional libraries and structured learning support systems, which reduce the quality of instructional delivery. Additionally, irregular electricity supply and poor internet connectivity hinder innovations that could enhance teaching and

learning. These gaps create a continuous cycle of educational disadvantage. Addressing these challenges requires a modern, technology-driven approach that enhances learning continuity across contexts. Therefore, improving sustainable learning in rural areas demands the integration of digital innovative practices to support long-term educational outcomes.

Digital innovative practices are defined as the creative use of technology-based tools and strategies to enhance teaching and learning effectiveness in diverse educational environments (Sugiarto & Rosidi, 2024). This definition underscores technology as a driver of transformation in instructional processes. Another definition describes digital innovative practices as systematic applications of digital resources, platforms, and methodologies aimed at improving accessibility, engagement, and sustainability in learning (Ogbo, 2025). Similarly, Rupia et al. (2026) maintained that the integration of artificial intelligence and other digital technologies in education enhances learners' digital literacy skills by promoting technological competence, independent learning, critical thinking, and effective utilization of digital resources for academic purposes. This perspective emphasizes the capacity of innovative digital tools to equip learners with essential twenty-first-century skills while improving educational outcomes. Both definitions emphasize technology-enabled improvements necessary for strengthening sustainable learning in rural secondary schools of Anambra State.

The theoretical foundation supporting digital innovative practices is the Diffusion of Innovation Theory by Rogers (2003), which explains how new ideas, technologies and innovations spread through social systems to improve performance and adaptability. The theory highlights the processes of awareness, adoption and implementation of new technologies, showing how stakeholders in education gradually embrace innovations that support teaching and learning. This theoretical lens strengthens the argument that digital tools can transform instructional delivery when adequately adopted in rural contexts.

This theory argues that innovation adoption depends on perceived usefulness, compatibility and ease of use, making it relevant to rural educational contexts where technology gaps exist. It also emphasizes the roles of early adopters, communication channels and organizational support in fostering technological change in schools. Therefore, the theory provides a framework for analysing technology integration in rural environments. In line with this, the theory ultimately reinforces the importance of mobile phone-based learning, offline digital learning resources and open educational resources.

The assessment of mobile phone-based learning is essential because mobile devices are the most accessible digital tools in rural communities, where over 78% of households possess at least one basic smartphone (Wahyui, et. al., 2024). Mobile learning enhances sustainable learning by enabling

students to access lessons, audio materials and interactive applications even outside the classroom. Furthermore, teachers use mobile devices to deliver instructions through WhatsApp, SMS and recorded videos, thereby reducing instructional gaps caused by teacher shortages. Evaluating mobile learning reveals its ability to promote continuous learning despite infrastructural limitations. This assessment naturally leads to examining offline digital learning resources and open educational resources as complementary tools for strengthening sustainable learning.

Offline digital learning resources, such as preloaded tablets, portable projectors, solar-powered learning kits and offline learning applications, are increasingly used to support learning in rural secondary schools lacking reliable internet connectivity (Sophonhiranrak, 2021). Assessing these tools helps determine their capacity to enhance content accessibility, improve retention and promote independent study. Similarly, open educational resources (OERs) provide free, adaptable and reusable academic materials that strengthen sustainable learning when integrated effectively (Sanabria-Z, et. al., 2024). Evaluating OER adoption in rural schools shows how teachers and students benefit from unrestricted access to quality educational content. These assessments further highlight the importance of using digital innovative practices to improve sustainable learning in rural contexts.

Given the persistent learning challenges in rural areas of Anambra State including limited infrastructure, irregular teacher deployment and inadequate access to quality instructional materials that there is a growing need to adopt digital innovative practices to sustain learning (Gisip, et. al., 2024). These innovations help mitigate barriers by providing flexible, accessible and cost-effective learning opportunities that do not rely heavily on physical infrastructure. Additionally, they offer rural learners' multiple pathways to engage with instructional content, thereby reducing disparities between rural and urban schools. Overcoming these challenges requires a systematic evaluation of how digital innovations function in rural settings. Thus, there is a need to assess the roles of digital innovative practices on sustainable learning in secondary schools in rural areas of Anambra State.

Secondary schools in rural areas of Anambra State in ideal situation should consistently experience sustainable learning supported by effective digital innovative practices that enhance access, continuity and quality of instruction. However, the reality shows that many rural schools still struggle with limited digital facilities, inadequate teacher competence in digital pedagogy, poor connectivity and insufficient exposure to mobile learning, offline digital resources and open educational materials. These challenges result in fragmented learning experiences, reduced student engagement and persistent disparities between rural and urban schools. Consequently, there is a pressing need to assess how digital innovative practices currently function and the extent to which they contribute to sustainable learning in rural secondary schools within Anambra State.

The broad objective is to assess the roles of digital innovative practices on sustainable learning in secondary schools in rural areas of Anambra State. Specifically, this study seeks to assess:

1. the roles of mobile phone–based learning on sustainable learning in secondary schools in rural areas of Anambra State.
2. the roles of offline digital learning resources on sustainable learning in secondary schools in rural areas of Anambra State.
3. the roles of open educational resources on sustainable learning in secondary schools in rural areas of Anambra State.

The study will be guided by the following research questions

1. What are the roles of mobile phone–based learning on sustainable learning in secondary schools in rural areas of Anambra State?
2. What are the roles of offline digital learning resources on sustainable learning in secondary schools in rural areas of Anambra State?
3. What are the roles of open educational resources on sustainable learning in secondary schools in rural areas of Anambra State?

METHODOLOGY

This study adopted a descriptive survey research design. The population of the study consisted of 51,444 students enrolled in public secondary schools in Anambra State. The sample size for the study was determined using Taro Yamane’s formula, which yielded 397 respondents drawn from the population. A simple random sampling technique was used to select the respondents to ensure equal opportunity for participation and to minimize bias. The instrument for data collection was a self-developed questionnaire titled Mobile and Digital Learning Resources and Sustainable Learning Questionnaire (MDLRSLQ). The questionnaire was structured into four clusters, each corresponding to the research questions of the study. Each cluster contained eight (8) items, making a total of 24 items. The instrument was designed on a 4-point rating scale as follows: Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). This scale was used to obtain the degree of agreement of respondents on each item. The instrument was subjected to face and content validation by three research experts: two from Educational Technology and one from Measurement and Evaluation. Their corrections and suggestions were used to modify the final version of the instrument before administration. The reliability of the instrument was determined using Cronbach’s Alpha

method. A trial test was conducted using 20 students from public secondary schools in Enugu State, which was outside the study area. The data obtained from the trial test were analyzed, and the instrument yielded reliability coefficients of 0.855, 0.812 and 0.871. The average reliability coefficient was 0.846. This average coefficient confirmed its internal consistency and suitability for data collection. Data for the study were collected by the researcher with the help of trained research assistants. The questionnaires were administered and retrieved on the spot to ensure a high return rate. The data collected were analyzed using mean and standard deviation to answer the research questions. A decision rule was established such that any item with a mean score of 2.50 and above was regarded as agreed, while any item below 2.50 was regarded as disagreed. Standard deviation was used to determine the closeness of responses among the respondents.

RESULTS

What are the roles of mobile phone–based learning on sustainable learning in secondary schools in rural areas of Anambra State?

Table 1: Mean Ratings on the Roles of Mobile Phone–Based Learning on Sustainable Learning

S/N	Item Statements	Mean	SD	Decision
1	Mobile phones help students access educational materials easily	3.41	0.76	Agree
2	Mobile phone learning improves students’ understanding of lessons	3.32	0.82	Agree
3	Students use mobile phones to conduct academic research	3.28	0.71	Agree
4	Mobile phone learning increases students’ participation in learning activities	3.16	0.80	Agree
5	Mobile phones promote continuous learning outside the classroom	3.35	0.74	Agree
6	Mobile phone learning enhances communication between students and teachers	3.11	0.88	Agree
7	Mobile phones encourage independent learning among students	3.26	0.69	Agree
8	Mobile phone–based learning improves academic performance of students	3.39	0.77	Agree
Grand Mean		3.29	0.77	Agree

The data presented in Table 1 revealed that all the items had mean scores above the criterion mean of 2.50. The grand mean of 3.29 indicated that respondents agreed that mobile phone–based learning played significant roles in promoting sustainable learning in secondary schools in rural areas of Anambra State. The findings showed that mobile phone learning enhanced access to educational

materials, improved students' understanding of lessons, encouraged independent learning, and promoted continuous learning outside the classroom. The relatively low standard deviation values also indicated that the respondents had similar opinions on the items presented.

Research Question Two

What are the roles of offline digital learning resources on sustainable learning in secondary schools in rural areas of Anambra State?

Table 2: Mean Ratings on the Roles of Offline Digital Learning Resources on Sustainable Learning

S/N	Item Statement	Mean	SD	Decision
1	Offline digital resources improve students' access to learning materials	3.30	0.73	Agree
2	Offline digital learning supports teaching in areas without internet access	3.47	0.70	Agree
3	Students learn better through recorded digital lessons	3.25	0.84	Agree
4	Offline digital resources improve students' retention of knowledge	3.18	0.81	Agree
5	Teachers effectively use offline digital materials for classroom instruction	3.09	0.86	Agree
6	Offline digital learning encourages self-paced learning among students	3.27	0.76	Agree
7	Offline digital resources reduce interruption in learning activities	3.21	0.80	Agree
8	Offline digital learning resources improve students' academic engagement	3.36	0.72	Agree
Grand Mean		3.27	0.78	Agree

The findings in Table 2 showed that all the items recorded mean scores above the benchmark mean of 2.50. The grand mean score of 3.27 indicated that respondents agreed that offline digital learning resources contributed positively to sustainable learning in secondary schools in rural areas of Anambra State. The findings demonstrated that offline digital resources improved access to instructional materials, supported learning in areas with poor internet connectivity, promoted self-paced learning, and enhanced students' academic engagement. The standard deviation scores revealed that respondents' opinions were closely related and consistent across the questionnaire items.

Research Question Three

What are the roles of open educational resources on sustainable learning in secondary schools in rural areas of Anambra State?

Table 3: Mean Ratings on the Roles of Open Educational Resources on Sustainable Learning

S/N	Item Statements	Mean	SD	Decision
1	Open educational resources provide free access to learning materials	3.44	0.69	Agree
2	Open educational resources improve students' learning opportunities	3.31	0.75	Agree
3	Teachers use open educational resources to support classroom teaching	3.18	0.84	Agree
4	Open educational resources encourage collaborative learning among students	3.20	0.81	Agree
5	Open educational resources improve students' academic achievement	3.37	0.72	Agree
6	Open educational resources increase students' interest in learning	3.29	0.76	Agree
7	Open educational resources promote continuous learning among students	3.41	0.70	Agree
8	Open educational resources support equal educational opportunities for students	3.33	0.79	Agree
Grand Mean		3.32	0.76	Agree

The result in Table 3 indicated that all the items had mean scores above the criterion mean of 2.50. The grand mean of 3.32 showed that respondents agreed that open educational resources played important roles in promoting sustainable learning in secondary schools in rural areas of Anambra State. The findings revealed that open educational resources provided free access to educational content, improved learning opportunities, enhanced academic achievement, and promoted equal educational opportunities among students. The low standard deviation values further indicated that the respondents shared similar views regarding the roles of open educational resources in sustainable learning.

Discussion of Findings

The finding revealed that mobile phone-based learning significantly supports sustainable learning in secondary schools in rural areas of Anambra State. This aligns with Sophonhiranrak's (2021) view that mobile learning enhances access, flexibility, and learner engagement. Similarly, Näykki and

Häkkinen (2023) noted that mobile devices promote continuous and learner-centred education. However, Errabo and Ongoco (2019) criticised mobile learning for distractions and unequal access among rural students. Despite these concerns, the high mean scores show that mobile phones improve understanding, participation, and independent learning. The corresponding hypothesis was accepted, indicating a significant positive role of mobile phone-based learning on sustainable learning outcomes.

The findings showed that offline digital learning resources play a significant role in enhancing sustainable learning in rural secondary schools. This supports the position of Ni (2026), who argued that offline digital tools are essential in low-connectivity environments for equitable education delivery. Likewise, Umar and Argungu (2025) emphasized their effectiveness in supporting self-paced learning. However, Narh-Kert (2026) criticised offline resources for limited interactivity compared to online systems. Despite these limitations, the study revealed strong positive responses from students. Therefore, the null hypothesis was rejected, indicating a significant influence of offline digital resources on sustainable learning outcomes.

The result showed that open educational resources significantly promote sustainable learning in rural secondary schools in Anambra State. This supports McGreal (2017), who stated that open resources enhance access, equity, and collaboration in education. Similarly, Ossiannilsson, et. al., (2020) found that OER improves academic achievement and reduces learning costs. However, Otto and Kerres (2022) criticised OER for issues of quality control and lack of contextual relevance in developing regions. Despite these criticisms, the findings confirmed strong positive perceptions. Thus, the hypothesis was rejected, indicating a significant role of open educational resources in enhancing sustainable learning in rural secondary schools.

Conclusion

Based on the findings, it was concluded that mobile phone-based learning, offline digital learning resources, and open educational resources significantly enhance sustainable learning in secondary schools in rural areas of Anambra State. These digital learning tools improve access to instructional materials, promote independent learning, and increase students' academic engagement and performance. The study also established that despite infrastructural and connectivity challenges, digital learning resources remain essential for bridging educational gaps in rural schools. Overall, technology-driven learning strategies were found to be effective in supporting continuous and inclusive education. Therefore, integrating digital learning tools into secondary education is crucial for sustainable educational development in rural settings.

Recommendations

1. Government and school administrators should provide more mobile learning support systems, including subsidised data and digital devices, to enhance students' access to educational content.
2. Schools in rural areas should be equipped with offline digital learning resources such as preloaded tablets, projectors, and offline educational software to support teaching and learning.
3. Educational policymakers should promote the adoption and proper use of open educational resources by training teachers and students on how to effectively access, evaluate, and integrate OER into classroom instruction.

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