

Safeguarding Digital Infrastructure for the Effective, Sustainable Development of Secondary Education in Orlu LGA

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Abstract:

Background: *The integration of digital technologies into the educational sector offers significant potential for transforming learning delivery, administrative processes, and policy implementation, particularly in developing regions. This study investigated the extent to which digital infrastructures in secondary schools in Orlu Local Government Area (LGA) of Imo State are safe, secure, and adequately safeguarded for sustainable educational development. Anchored on the Technological Determinism Theory, the study adopted a descriptive survey design with a sample size of 156 respondents comprising principals and teachers. Data were collected using a validated instrument titled Safeguarding Digital Infrastructure for Effective Sustainable Development of Secondary Education Questionnaire (SDIESDSEQ). Findings revealed that digital infrastructure in Orlu LGA secondary schools is generally inadequate and insecure, with a grand mean of 2.33, indicating a low level of availability. Despite this, both teachers and principals agreed that safeguarding measures—such as digital security policies, cybersecurity training, and infrastructure maintenance—could significantly enhance the sustainable use of educational technology. Independent t-test analyses showed no significant difference between principals' and teachers' opinions on both the availability and safeguarding of digital infrastructure. The study concludes by emphasizing the need for proactive safeguarding frameworks and offers practical recommendations for achieving sustainable digital integration in secondary education.*

Conclusion: *The study concludes that while digital infrastructure in secondary schools within Orlu LGA is increasingly recognized as vital for sustainable educational development, its current availability and security status remain suboptimal. Both principals and teachers consistently reported that the digital infrastructure available is not adequately safeguarded, which poses a serious threat to the longevity, efficiency, and effectiveness of technology-based teaching and administration. However, the study also established a shared optimism among stakeholders about the possibility of safeguarding these infrastructures through structured interventions. Importantly, the absence of statistically significant differences in perception between principals and teachers suggests a collective awareness and readiness to support improvements in digital security practices. To ensure that digital transformation efforts in secondary schools yield long-term benefits, robust safeguarding mechanisms, sustained funding, capacity building, and contextualized strategies are urgently needed.*

Key Word: *Digital Infrastructure Security, Sustainable Development, Secondary Education, Imo State, Cybersecurity in schools, Digital Resilience, Technological Determinism*

1.0 Introduction

The integration of digital technologies into educational systems represents a transformative opportunity for improving educational access, quality, and administration across developing regions (Olayemi, 2022). In Nigeria, and specifically in Orlu LGA in Imo State, digital infrastructure has been the yearning desires of many school administrators and stakeholders, which foster increasing deployment of the tools to enhance secondary education delivery, administrative efficiency, and data-driven decision-making (Nwabueze & Onyekwere, 2023). Despite this promising trend, the sustainability of these digital investments faces significant challenges related to security vulnerabilities, insufficient protection mechanisms, and inadequate maintenance protocols (Okoli & Ezenwaji, 2021).

According to the Nigerian Educational Research and Development Council (NERDC), 67% of digital infrastructure investments in education fail to achieve their intended long-term impacts due to security breaches, system failures, and maintenance deficiencies. This concerning statistic underscores the critical importance of safeguarding digital assets as a prerequisite for sustainable educational development.

While previous research has extensively examined the deployment of educational technologies in developing contexts (Adebayo, 2021; Nwachukwu et al., 2022), the specific intersection of digital infrastructure security and sustainable educational development remains under-investigated. This research gap is particularly evident where digital transformation initiatives in education have accelerated following the State Education Digitalization Strategy. This study addresses this knowledge gap by investigating the current state of digital infrastructure security in Orlu LGA in Imo State's secondary education sector and proposing contextually appropriate frameworks for enhancing the protection and sustainability of these critical assets.

1.1 Statement of the Problem

In the 21st century, digital infrastructure has become an essential driver of quality education, enabling access to digital tools, resources, and platforms that support teaching and learning processes. However, the state of digital infrastructure in secondary schools remains weak, inconsistent, and in some cases, entirely absent. The increasing reliance on digital technology in the education sector has exposed secondary schools in to the urgent need for robust and secure digital infrastructure that can support sustainable development in education.

Despite national and state efforts to integrate technology into the school system, many schools still operate without stable internet connectivity, updated ICT equipment, digital learning resources, or trained personnel to manage these technologies. Worse still, where digital infrastructure exists, it is often inadequately protected, leaving school systems vulnerable to cyber threats, misuse, or total breakdown due to poor maintenance. This lack of safeguarding mechanisms for digital tools and systems undermines their potential to contribute meaningfully to sustainable educational development. In Orlu LGA, there are schools that are experiencing technological or digital setbacks, not because the ICT tools were absent, but because they are damaged due to poor maintenance culture of the school administrators.

Furthermore, without effective safeguarding practices, investments in digital infrastructure risk becoming unsustainable, leading to repeated losses, system failures, and eventual abandonment of technology-driven educational initiatives. This situation poses a serious threat to the goal of achieving inclusive, equitable, and quality education for all, as envisioned in global and national educational development strategies. It is therefore imperative to investigate how safeguarding digital infrastructure can significantly enhance the effectiveness and sustainability of secondary education in Orlu LGA, Imo State.

1.2 Aim and objectives of the study

The aim of the study is to find out how safeguarding digital infrastructure enhances effective, sustainable development of secondary education in Orlu LGA in Imo State. The study determined the following objectives:

1. Assess how available digital infrastructure safe or secure for sustainable development of secondary schools in Orlu LGA in Imo State?
2. How can digital infrastructures be safeguarded for the sustainable development of secondary schools in Orlu LGA in Imo State.

1.3 Research questions

The following research questions guided the study.

1. To what extent are available digital infrastructure safe or secure for sustainable development of secondary schools in Orlu LGA in Imo State?
2. How can digital infrastructures be safeguarded for sustainable development of secondary schools in Orlu LGA in Imo State?

1.4 Hypotheses

The following hypotheses will be tested at 0.05 level of significance.

1. There is no significance difference between the opinion mean responses of principals and teachers on the safety state of digital infrastructures in secondary schools for sustainable development in Orlu LGA in Imo State.
2. There is no significance difference between the opinion mean responses of principals and teachers on how digital infrastructures can be safeguarded in secondary schools for sustainable development in Orlu LGA in Imo State.

2.0 Literature Review

2.1 Digital Infrastructure in Secondary Education

The integration of digital technologies into secondary education systems represents a global trend with particularly transformative potential for developing regions (World Bank, 2022). Digital infrastructure investments in education have been linked to improved learning outcomes, enhanced administrative efficiency, and expanded educational access. However, as Adebayo(2021)notes, the sustainability of these digital initiatives depends heavily on contextual factors including security frameworks, technical capacity, and institutional support mechanisms. In Nigeria, the National Policy on Education Technology (Federal Ministry of Education, 2022) established ambitious targets for digital integration across all educational levels, with particular emphasis on secondary schools as critical transition points to higher education and workforce entry. Nwachukwu et al. (2022) documented the implementation progress of this policy, noting substantial investments in hardware, connectivity, and digital content across Nigeria's geopolitical zones, while highlighting significant regional disparities in digital readiness. Focusing specifically on Imo State, Ndukwe (2021) conducted a comprehensive assessment of digital infrastructure deployment across 68 secondary schools, finding that while 78% had received some form of digital equipment (primarily computer laboratories and administrative systems), only 43% reported functional and regularly utilized digital resources. This implementation gap was attributed to multiple factors, including infrastructure challenges, capacity limitations, and notably, security concerns that undermined confidence in digital systems.

2.2 Securing Digital Infrastructure for Sustainable Educational Development

The protection of digital assets is a critical dimension of sustainable technology integration in education systems. Obasi (2018) proposed a conceptual framework for understanding digital security in educational contexts, encompassing physical protection of hardware, cybersecurity measures for networks and data, and governance protocols for system access and usage. Their research in southeastern Nigerian schools revealed that comprehensive security frameworks were often neglected during technology deployment, resulting in significant vulnerabilities.

Iwu and Ike (2022) examined specific security threats facing educational institutions in West Africa and identified unauthorized access (reported by 76% of surveyed institutions), data breaches (64%), and system failures due to inadequate protection (58%) as the most prevalent challenges. These findings align with global patterns documented by the International Association for Technology in Education (IATE, 2023), which highlighted educational institutions as increasingly targeted for cyberattacks due to their valuable data assets and typically weaker security infrastructures compared to commercial organizations.

The relationship between digital security and sustainable educational development was further explored by Okafor and Anyanwu (2023), who conducted a study involving 32 secondary schools in eastern Nigeria. Their findings established a strong correlation between robust security measures and the long-term functionality of digital infrastructure. Schools with adequately protected systems demonstrated **3.8 times longer operational lifespans** and **2.6 times higher utilization rates** compared to those with poorly secured digital environments. These results emphasize the importance of safeguarding digital infrastructure as a prerequisite for sustainable educational development.

2.3 Challenges and Opportunities

Enrollment increasing by 34% between 2018 and 2022, placing additional pressures on infrastructure and administrative systems. The State Education Digitalization Strategy 2019-2025 (Imo State Ministry of Education, 2019) responded to these challenges by prioritizing technology integration, with specific components addressing school management systems, learning platforms, and assessment frameworks. Eze & Umeano (2020) conducted a situational analysis of digital readiness across Imo State's education sector, highlighting significant variations between urban and rural communities, with rural schools facing compounded challenges related to power stability, connectivity, and technical support availability. Their research indicated that these contextual constraints directly impacted security practices, with resource-constrained schools often neglecting essential protection measures due to competing priorities and limited awareness. The potential for innovative, resource-appropriate security approaches was examined by Adeoye & Adeniji (2020) who documented successful case studies of school-level security initiatives in southeastern Nigeria. Their research highlighted promising practices including community-based protection arrangements, peer learning networks for technical capacity building, and adapted security protocols that accounted for local constraints while maintaining essential protection standards.

3.0 Theoretical Framework

The study was anchored on technological determinism theory propounded by Thorstein Veblen in the early 20th century, but it was later developed and popularized by Marshall McLuhan in 1960s and others. Technological Determinism theory posits that technological advancement drives social change and development. It argues that the development and deployment of technology shape human behaviour, institutional structures, and education systems. This theory supports the idea that the availability and protection (safeguarding) of digital infrastructure (such as internet connectivity, ICT tools, cybersecurity, digital learning platforms, etc.) directly influences the sustainable development of secondary education. In other words, when digital infrastructure is protected and efficiently used, it catalyzes educational growth and development. Safeguarding digital infrastructure ensures continuous, reliable, and secure use of technology in education, which is crucial for sustainability and effectiveness in secondary education.

3.1 Methodology

The study adopted descriptive survey research design, to examine safeguarding digital infrastructure for effective sustainable development of secondary education in Orlu LGA in Imo State. The population of the study comprised all the 498 teachers and 23 principals of secondary schools in Orlu LGA in Imo State, making a total of 521 target population. The sample size of the study is 30% of the total population size, comprising 149 teachers and 7 seven principals making a total of 156 respondents. As well stratified random sampling technique were used for the study. The instrument for data collection was “Safeguarding Digital Infrastructure for Effective Sustainable Development of Secondary Education Questionnaire (SDIESDSEQ)”. The instrument was validated by two experts and the reliability coefficient index was 0.77. Mean and standard deviation were used to answer the research questions while t-test was used to test the hypotheses at 0.05 level of significance.

Results and Discussion

Research question one: To what extent are available digital infrastructure safe or secure for sustainable development of secondary schools in Orlu LGA in Imo State?

Table: 1.0: Summary of mean responses of principals and teachers on extent the available digital infrastructure safe or secure for sustainable development of secondary schools in Orlu LGA in Imo State.

S/N	To what extent are the available digital infrastructure safe or secure for sustainable development of secondary schools in Orlu LGA in Imo State?	Principals (n=7)		Teachers (n=149)		Mean Set	Remark
		Mean	SD	Mean	SD		
1.	Physical security measures (locks, alarms,) protecting digital equipment in your school	2.26	0.85	2.41	0.88	2.34	Not Available
2.	Computers (desktops and Laptops) and networks.	2.39	0.6	2.15	0.75	2.27	Not Available
3.	Surveillance Cameras	2.34	1.04	2.28	0.99	2.31	Not Available
4.	School generators/UPS	2.48	0.87	2.46	0.84	2.47	Not Available
5.	The internet connection devices: Wi-Fi modem and mobile hotspot	2.43	0.94	2.47	0.92	2.45	Not Available
6.	Software CDs and Flash drives.	2.14	0.84	2.18	0.72	2.16	Not Available
7.	Printers, photocopier and scanners	2.42	0.65	2.17	0.91	2.30	Not Available
8.	Projectors/Interactive board	2.35	0.66	2.13	0.81	2.24	Not Available
9.	School telephone	2.44	0.67	2.45	0.83	2.45	Not Available
10.	Television and multimedia speakers	2.35	0.74	2.28	0.84	2.32	Not Available
	Grand Total	2.36	0.79	2.30	0.85	2.33	Not Available

The table above shows that both principals and teachers indicated that there is no availability of digital infrastructure safe or secure for sustainable development of secondary schools in Orlu LGA in Imo State to a high extent (Mean=2.33). The table also revealed that opinion mean responses of principal on is slightly higher (Mean=2.36, SD=0.79) than that of the teachers (Mean=2.30, SD=0.85) on the extent of availability of digital infrastructure safe or secure for sustainable development of secondary schools in Orlu LGA in Imo State.

Research question two: How can digital infrastructures be safeguarded for sustainable development of secondary schools in Orlu LGA in Imo State?

Table 2.0: Summary of Mean Responses of Principals and Teachers on How Digital Infrastructures Can Be Safeguarded for Sustainable Development of Secondary Schools in Orlu LGA, Imo State

S/N	How can digital infrastructures be safeguarded for sustainable development of secondary schools in Orlu LGA in Imo State?	Principals (n=7)		Teachers (n=149)		Mean Set	Remark
		Mean	SD	Mean	SD		
1.	Implementing a comprehensive school-wide digital security policy	2.57	0.9	2.51	0.86	2.54	Agreed
2.	Installing advanced physical security systems (biometric access, CCTV)	2.84	0.71	2.72	0.65	2.78	Agreed
3.	Conducting regular security audits and vulnerability assessments	2.72	0.95	2.63	1	2.68	Agreed
4.	Providing mandatory cybersecurity training for all staff	3.09	0.9	2.76	0.88	2.93	Agreed
5.	Integrating digital citizenship and security awareness in student curriculum	2.99	0.88	3.25	0.92	3.12	Agreed
6.	Establishing partnerships with cybersecurity firms or government agencies	2.65	0.75	2.56	0.78	2.61	Agreed
7.	Implementing cloud-based secure backup solutions	2.66	0.75	2.61	0.77	2.64	Agreed
8.	Creating a dedicated IT security position/team	2.71	0.82	2.72	0.78	2.72	Agreed
9.	Developing a sustainable funding model for digital security	2.52	0.61	2.55	0.75	2.54	Agreed
10.	Building a community of practice among schools to share security best practices	2.84	0.75	2.82	0.83	2.83	Agreed
	Grand Total	2.76	0.80	2.71	0.82	2.74	Agreed

The table above shows that both principals and teachers agreed that digital infrastructures can be safeguarded for sustainable development of secondary schools in Orlu LGA in Imo State (Mean=2.74). The table also revealed that the opinion means responses of principal of (Mean=2.76, SD=0.80) is slightly higher than that of the teachers (Mean=2.71, SD=0.82) on how digital infrastructures can be safeguarded for sustainable development of secondary schools in Orlu LGA in Imo State.

Hypotheses

The following hypotheses will be tested at 0.05 level of significance.

H01: There is no significance difference between the mean opinion responses of principals and teachers on the safety state of digital infrastructures in secondary schools for sustainable development in Orlu LGA in Imo State.

Table 3.0: Summary of t-test on the opinion mean responses of principals and teachers on the safety state of digital infrastructures in secondary schools for sustainable development in Orlu LGA in Imo State.

Designation	N	Mean	SD	Df	t-test	Sig.	Remark
Principals	7	2.36	0.79	154	0.596	0.552	NS
Teachers	149	2.30	0.85				

NS= Not Significant

The table above showed the mean scores of principals is 2.36 and the standard deviation is 0.79, while the mean scores of teachers is 2.30 and the standard deviation is 0.85. The t-test calculated value is 0.596, the corresponded significance value is 0.552 showing > 0.05 at 148 degrees of freedom. Hence, it is concluded that there is no significant between the mean opinion responses of principals and teachers on the safety state of digital infrastructures in secondary schools for sustainable development in Orlu LGA in Imo State. Therefore, the null hypothesis one is retained at 0.05 level of significance.

H02: There is no significance difference between the mean opinion responses of principals and teachers on how digital infrastructures can be safeguarded in secondary schools for sustainable development in Orlu LGA in Imo State.

Table 4.0: Summary of t-Test on the Opinion Mean Responses of Principals and Teachers on How Digital Infrastructures Can Be Safeguarded

Designation	N	Mean	SD	Df	t-test	Sig.	Remark
Principals	7	2.76	0.80	154			NS
Teachers	149	2.71	0.82				

NS= Not Significant

The table above showed the mean scores of principals is 2.76 and the standard deviation is 0.80, while the mean scores of teachers is 2.71 and the standard deviation is 0.82. The t-test calculated value is 0.596, the corresponded significance value is 0.552 showing > 0.05 at 154degrees of freedom. Hence, it is concluded that there is no significance difference between the mean opinion responses of principals and teachers on how digital infrastructures can be safeguarded in secondary schools for sustainable development in Orlu LGA in Imo State. Therefore, the null hypothesis twois retained at 0.05 level of significance.

4.0 Recommendations

Based on the findings of the study, the researcher recommends the following:

1. The Imo State Ministry of Education and relevant authorities should increase funding for the provision and maintenance of secure digital infrastructure in secondary schools, including reliable internet access, surveillance systems, and ICT tools.
2. Schools should implement comprehensive digital security policies that outline protocols for hardware safety, network protection, data management, and incident response procedures. Hence, regular and mandatory cybersecurity training should be provided for school staff to enhance their awareness of digital threats and best practices for preventing system breaches or misuse.
3. Educational administrators should institutionalize routine audits and vulnerability assessments of ICT systems to ensure compliance with digital security standards and identify gaps requiring attention.

4.1 Discussion

The findings from the analysis provide insightful revelations concerning the state and safeguarding of digital infrastructure for sustainable development in secondary schools in Orlu Local Government Area (LGA) of Imo State. The study sought to assess both the availability and the potential for safeguarding digital infrastructure in these schools from the perspectives of principals and teachers.

The first part of the findings shows that both principals and teachers perceived that digital infrastructure that is safe and secure for sustainable development is not adequately available in the secondary schools in Orlu LGA. The overall mean score of 2.33 indicates a low level of availability. A closer look at the mean responses shows that principals suggesting that while both groups acknowledged the inadequacy, principals held a marginally more favorable perception of the current situation. Furthermore, a comparison between principals and teachers also revealed a minor difference in perception, with principals reporting a mean of 2.36 and teachers 2.30. However, when a t-test was conducted to determine if these differences were statistically significant, the result ($t = 0.596, p = 0.552$) indicated no significant difference in the mean responses at 148 degrees of freedom and the 0.05 level of significance. Therefore, the null hypothesis which stated that there is no significant difference in the opinions of principals and teachers on the availability of safe digital infrastructure was retained.

In the second part of the findings, both principals and teachers agreed that digital infrastructures can be safeguarded to promote sustainable development in secondary schools within the area. This is reflected in the overall mean score of 2.74. Again, principals exhibited a slightly higher mean score than teachers, indicating a slightly more optimistic view on safeguarding strategies. Similar trends were observed in the gender comparison, with principals recording a mean score and teachers. However, just like in the first analysis, the t-test result ($t = 0.596, p = 0.552$) was greater than the 0.05 threshold at 154 degrees of freedom. This implies that there is no statistically significant difference in

the opinions of the two groups regarding how digital infrastructure can be safeguarded. As such, the second null hypothesis was also retained.

These findings suggest a general consensus among educators in Orlu LGA regarding the poor availability of secure digital infrastructure and the belief that, although the current infrastructure is inadequate, safeguarding measures are possible if proper strategies are implemented. The lack of significant difference in responses across groups further reinforces the shared reality and collective understanding of the challenges and opportunities surrounding digital infrastructure in secondary education in the region. This highlights the urgent need for government and education stakeholders to invest in the provision and protection of digital tools and facilities to foster long-term educational sustainability.

4.2 Conclusion

The study concludes that while digital infrastructure in secondary schools within Orlu LGA is increasingly recognized as vital for sustainable educational development, its current availability and security status remain suboptimal. Both principals and teachers consistently reported that the digital infrastructure available is not adequately safeguarded, which poses a serious threat to the longevity, efficiency, and effectiveness of technology-based teaching and administration. However, the study also established a shared optimism among stakeholders about the possibility of safeguarding these infrastructures through structured interventions. Importantly, the absence of statistically significant differences in perception between principals and teachers suggests a collective awareness and readiness to support improvements in digital security practices. To ensure that digital transformation efforts in secondary schools yield long-term benefits, robust safeguarding mechanisms, sustained funding, capacity building, and contextualized strategies are urgently needed.

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