

Remote Learning Infrastructure and Curriculum Continuity in the Period of Emergencies Among Education Stakeholders in Kaduna State

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Abstract

This study examined remote learning infrastructure and curriculum continuity in the period of emergencies among Education stakeholders in Kaduna state, Nigeria. The research adopted correlational design with a population comprising education stakeholders including teachers, school administrators, ICT coordinators, and education officials across the state. A sample size of 400 participants was determined using Research Advisory (2006) sample size determination table through stratified random sampling and simple random sampling techniques. Data were collected using structured questionnaires titled "Remote Learning Infrastructure and Curriculum Continuity Questionnaire" (RLICCQ) and analyzed using pearson correlation and regression analysis. Results of this study revealed that insecurity significantly disrupted curriculum completion ($M = 3.76, SD = 0.84$), reduced instructional time by approximately 35% ($M = 3.82, SD = 0.78$), and negatively impacted students' academic performance ($M = 3.69, SD = 0.91$). All three null hypotheses were rejected at $p < 0.05$ significance level. The study concluded that persistent insecurity and consequent school closures have severely undermined educational delivery in Kaduna state. Recommendations include substantial investment in digital infrastructure, comprehensive teacher training programmes, development of context-appropriate digital content, and establishment of robust emergency education policies to ensure learning continuity during crises.

Keywords: Remote learning, infrastructure, curriculum continuity, emergency, education stakeholder

Introduction

The global education landscape has experienced unprecedented disruptions in recent years, particularly during the COVID-19 pandemic, which forced educational systems worldwide to rapidly transition to remote learning modalities (Landa et. al., 2021). This abrupt shift exposed significant disparities in educational technology infrastructure, particularly in developing countries where digital divides remain pronounced (Oni et. al., 2025). In Nigeria, the education sector confronted substantial challenges as schools closed their doors, necessitating alternative methods of instructional delivery to ensure learning continuity (Obiakor & Adeniran, 2020). The northern region, including Kaduna state, is faced with compounded difficulties due to infrastructure deficits, security challenges, and socioeconomic constraints that limited access to digital learning resources. Kaduna state, situated in northwestern Nigeria, represents a microcosm of the broader challenges facing Nigerian education during emergencies.

The state's educational system serves diverse populations across urban and rural settings, each with distinct technological access levels and infrastructure capabilities. Prior to recent emergency situations, the Kaduna state education system already grappled with issues including inadequate physical infrastructure, teacher shortages, and limited technological integration in pedagogical practices (Ramesh Vasudevan & Oyedele, 2024). When emergencies such as the COVID-19 pandemic, security threats, and school closures occurred, these underlying weaknesses became more apparent, threatening the continuity of education for thousands of learners across the state. The concept of education in emergencies has gained increased attention globally, with recognition that learning must continue even during crises to maintain educational progress and provide psycho-social support to affected learners (United Nations Educational, Scientific and Cultural Organization, 2021).

Emergency remote teaching differs from planned online education, as it represents rapid responses to crisis situations without the typical preparation time for curriculum redesign, teacher training, or infrastructure development (Ikwuka, 2021). In Kaduna state, efforts to implement remote learning during emergencies revealed critical gaps in technological infrastructure, internet connectivity, electricity supply, device availability, and digital literacy among both educators and learners (Bashir et. al., 2021). Recent initiatives by the Kaduna state government, including collaboration with UNICEF

to digitize the Education Management Information System and establish real-time data dashboards, demonstrate recognition of the importance of technological integration in education (Yinusa, 2025). These efforts align with broader national priorities outlined in Nigeria's National Digital Learning Policy, which aims to bridge the digital divide and reach underserved communities (Federal Ministry of Education, 2023).

However, significant challenges remain in translating policy intentions into practical implementation, particularly in ensuring equitable access to remote learning opportunities across different geographic and socioeconomic contexts within the state. The infrastructure requirements for effective remote learning extend beyond mere device availability to encompass reliable electricity supply, affordable internet connectivity, appropriate digital content, and educators equipped with necessary technological competencies (Dele-Ajayi & Taddese, 2020). Curriculum continuity during emergencies requires not only technological infrastructure but also pedagogical adaptations, assessment modifications, and support systems for learners facing diverse challenges (United Nations International Children's Emergency Fund, 2024). Despite global recognition of the importance of education continuity during emergencies, Kaduna state faces persistent challenges in establishing robust remote learning infrastructure capable of supporting effective curriculum delivery when traditional schooling is disrupted (Ramesh, Vasudevan & Oyedele, 2024).

The COVID-19 pandemic exposed critical weaknesses in the state's educational technology infrastructure, with many learners unable to access remote learning opportunities due to lack of devices, unreliable internet connectivity, electricity shortages, and limited digital literacy (Bashir et. al., 2021). These infrastructure deficits have been further compounded by security-related school closures in northern Nigeria, where over 618 schools closed in 2022 due to fears of attacks and abductions, resulting in significant learning losses (UNICEF, 2022). The digital divide between urban and rural areas in Kaduna state creates substantial inequities in access to remote learning, with rural communities facing more severe infrastructure constraints including limited electricity access and minimal internet penetration (Bashir et. al., 2021). Public schools generally lack the technological resources available in private institutions, widening educational disparities during emergencies when remote learning becomes necessary (Akinbobola, 2021).

This study anchored on Systems Theory by Ludwig Von Bertalanffy (1950) conceptualizes educational systems as complex, interconnected entities comprising multiple interdependent components that collectively influence outcomes (Miller, 2025). In the context of emergency education, Systems Theory provides a framework for understanding how various elements, including infrastructure, human resources, policies, and external environmental factors, interact to determine the effectiveness of remote learning and curriculum continuity. The theory posits that education systems must maintain dynamic equilibrium and adapt to changing conditions to remain functional during disruptions (Miller, 2025). Weakness in any subsystem creates ripple effects throughout the entire system, potentially compromising educational outcomes. For instance, even when devices are available, inadequate electricity supply or poor internet connectivity renders them ineffective, demonstrating the interdependence of system components (UNESCO, 2021).

The theory emphasizes that effective emergency education responses require holistic approaches addressing multiple system components simultaneously rather than isolated interventions targeting single elements. This perspective aligns with UNESCO's (2021) conceptual framework for education in emergencies, which advocates for integrated approaches spanning prevention, preparedness, response, and recovery phases. In Kaduna state's context, Systems Theory suggests that building resilient remote learning infrastructure requires coordinated investments in technological hardware, connectivity infrastructure, power supply, educator training, digital content development, and supportive policies.

The Technology Acceptance Model developed by Davis (1989) provides theoretical foundation for understanding factors influencing educators' and learners' adoption of remote learning technologies during emergencies. TAM posits that technology acceptance is primarily determined by perceived usefulness (the degree to which individuals believe using a technology will enhance performance) and perceived ease of use (the degree to which individuals believe using a technology will be effortless) (Shittu et. al., 2023). These constructs influence attitudes toward technology use, which subsequently affects behavioral intentions and actual usage patterns.

In Nigerian educational contexts, research has validated TAM's applicability in explaining technology adoption patterns. A study by Abass et. al. (2021) on cloud computing adoption in Ogun state higher

education found that perceived usefulness, ease of use, attitude, and access cost significantly predicted technology acceptance. Similarly, Shittu et. al. (2023) demonstrated that TAM effectively explains WhatsApp social media platform acceptance for learning among Nigerian students, with the model accounting for 61% of variance in behavioral intentions. During emergencies, when rapid technology adoption becomes necessary, perceived ease of use becomes particularly critical as users lack extensive familiarization time (Ikwuka, 2021). The model also incorporates external variables such as infrastructure quality, internet reliability, and device availability, which influence both perceived usefulness and ease of use.

Furthermore, the extended Unified Theory of Acceptance and Use of Technology (UTAUT) incorporates additional constructs including facilitating conditions (organizational and technical infrastructure supporting technology use), social influence, and performance expectancy (Shittu et. al., 2023). These extensions are particularly relevant in emergency contexts where institutional support, peer influence, and performance pressures significantly impact technology adoption decisions. Understanding these factors enables education stakeholders to design interventions that address not only infrastructure provision but also the psychological and social dimensions influencing technology acceptance during crises.

Furthermore, many educators lack adequate training in emergency remote teaching methodologies and effective use of digital tools for instruction, limiting their capacity to deliver quality education through remote modalities. Curriculum continuity during emergencies requires coordinated planning, appropriate resources, and institutional preparedness that remain inadequate in Kaduna state's education system. The absence of comprehensive emergency education plans, insufficient allocation of resources for technological infrastructure, and limited coordination among education stakeholders impede effective responses when crises occur. Additionally, there is limited empirical evidence examining the specific infrastructure challenges affecting remote learning in Kaduna state and their relationship to curriculum continuity outcomes. This research gap necessitates systematic investigation to inform evidence-based interventions and policy decisions aimed at strengthening the state's capacity for education continuity during emergencies. Thus, the following objectives guided this study:

1. To assess the opinion of education stakeholders on the level of availability and adequacy of remote learning infrastructure in the period of emergencies among Kaduna state schools.
2. To examine the opinion of education stakeholders on the extent of curriculum continuity in the period of emergencies in Kaduna state schools.
3. To determine the relationship between remote learning infrastructure and curriculum continuity in the period of emergencies in Kaduna state schools. The following null hypotheses were tested at 0.05 level of significance:

H₀₁: There is no significant relationship between the level of availability and adequacy of remote learning infrastructure in the period of emergencies among Kaduna state schools.

H₀₂: There is no significant relationship between internet connectivity infrastructure and curriculum continuity in the period of emergencies in Kaduna state schools.

H₀₃: There is no significant relationship between remote learning infrastructure and curriculum continuity in the period of emergencies in Kaduna state schools.

Methodology

This study employed descriptive survey research design. The population of this study was comprised all education stakeholders in Kaduna state. These include school teachers, school administrators, ICT coordinators, education officers at local government education authorities and Ministry officials. Information obtained from Kaduna state Ministry of Education (2024), there are approximately 8,000 public and private schools across its 23 Local Government Areas. The target population specifically included educators and administrators. Therefore, a sample size of 400 participants was randomly selected using Research Advisory (2012) sampling determination table. The sample composition includes 200 teachers (100 from public schools and 100 from private schools), 80 school administrators, 60 ICT coordinators, 40 local government education officers, and 20 state ministry officials. The study employed a combination of stratified random sampling and simple random sampling techniques to ensure representativeness across different school types, geographic locations, and stakeholder categories. The stratification was based on three criteria: school location (urban vs. rural), school ownership (public vs. private) and education level (primary vs. secondary).

Structured questionnaire titled "Remote Learning Infrastructure and Curriculum Continuity Questionnaire" (RLICCCQ) was adopted for data collection in this study. The questionnaire comprised four sections namely sections A, B, C and D. Section A contains demographic information such as respondent category, school type, location, years of teaching experience and prior technology training. Section B assessed remote learning infrastructure availability, Section C measured curriculum continuity in the period of emergencies while Section D assessed perceived challenges of remote learning infrastructure and curriculum continuity. Reliability of the instrument was established through pilot testing with 40 respondents not included in the main study sample. Cronbach's alpha reliability coefficients were computed for each section: remote learning infrastructure section ($\alpha = 0.89$), curriculum continuity section ($\alpha = 0.86$), and overall instrument ($\alpha = 0.91$), indicating high internal consistency and reliability suitable for the study. Data analysis employed both descriptive and inferential statistics using Statistical Package for Social Sciences (SPSS) version 26.0. Descriptive statistics including frequencies, percentages, means, and standard deviations. Mean scores were interpreted using a benchmark of 3.00 (midpoint of the 5-point scale), with scores ≥ 3.00 indicating agreement/adequacy and scores < 3.00 indicating disagreement/inadequacy (Bashir et. al., 2021). Inferential statistics was employed to test the three null hypotheses. These include Pearson Product-Moment Correlation Coefficient and Multiple regression analysis.

Results

H₀₁: There is no significant relationship between the level of availability and adequacy of remote learning infrastructure in the period of emergencies among Kaduna state schools.

Table 1: Correlation Between Technological Device Availability and Curriculum Continuity

Variable	Mean	SD	r-value	p-value	Decision
Technological Device Availability	2.08	1.19	0.687	0.000	Reject H ₀₁
Curriculum Continuity	2.61	1.18			

Source: Field Survey (2024); N = 387; df = 385; Critical r-value = 0.687 at p < 0.05

Table 1 shows a significant positive relationship between technological device availability and curriculum continuity (r = 0.687, p = 0.000 < 0.05). Since the calculated r-value (0.687) exceeds the

critical r-value (0.098) and the p-value is less than 0.05, the null hypothesis was therefore rejected. This indicated that availability of technological devices significantly enhances curriculum continuity in the period of emergencies. The moderate-to-strong correlation ($r = 0.687$) suggests that approximately 47.2% of variance in curriculum continuity can be attributed to device availability.

H₀₂: There is no significant relationship between internet connectivity infrastructure and curriculum continuity in the period of emergencies in Kaduna state schools.

Table 2: Correlation Between Internet Connectivity and Curriculum Continuity

Variable	Mean	SD	r-value	p-value	Decision
Internet Connectivity Infrastructure	2.24	1.19	0.712	0.000	Reject H ₀₂
Curriculum Continuity	2.61	1.18			

Source: Field Survey (2024); $N = 387$; $df = 385$; Critical r-value = 0.712 at $p < 0.05$

Table 2 reveals a significant positive relationship between internet connectivity infrastructure and curriculum continuity ($r = 0.712$, $p = 0.000 < 0.05$). The null hypothesis is rejected as the calculated r-value exceeds the critical value. Internet connectivity demonstrated the second-strongest correlation among infrastructure components, explaining approximately 50.7% of curriculum continuity variance. This finding underscores the critical role of reliable internet access in facilitating synchronous and asynchronous remote learning activities.

H₀₃: There is no significant relationship between remote learning infrastructure and curriculum continuity in the period of emergencies in Kaduna state schools..

Table 3: Correlation Between Educator Digital Competencies and Curriculum Continuity

Variable	Mean	SD	r-value	p-value	Decision
Educator Digital Competencies	2.56	1.16	0.731	0.000	Reject H ₀₃
Curriculum Continuity	2.61	1.18			

Source: Field Survey (2024); $N = 387$; $df = 385$; Critical r-value = 0.098 at $p < 0.05$

Table 3 indicates the strongest significant positive relationship among tested variables, between educator digital competencies and curriculum continuity ($r = 0.731, p = 0.000 < 0.05$). The null hypothesis was subsequently rejected. This relationship accounts for approximately 53.4% of curriculum continuity variance, highlighting that human capacity supersedes technological infrastructure in determining emergency remote teaching effectiveness.

Table 4: Multiple Regression Analysis of Infrastructure Components Predicting Curriculum Continuity

Predictor Variable	B	SE	β	t-value	p-value
(Constant)	0.312	0.187	-	1.668	0.096
Technological Devices	0.245	0.042	0.247	5.833	0.000*
Internet Connectivity	0.289	0.038	0.291	7.605	0.000*
Educator Competencies	0.367	0.041	0.361	8.951	0.000*

$R = 0.836; R^2 = 0.699; Adjusted R^2 = 0.697; F(3, 383) = 297.45; p < 0.001$

*Source: Field Survey (2024); Significant at $p < 0.05$

Table 4 presents multiple regression results showing that the three infrastructure components collectively predict 69.9% of variance in curriculum continuity ($R^2 = 0.699, F(3, 383) = 297.45, p < 0.001$). All three predictors contributed significantly: educator digital competencies ($\beta = 0.361, p < 0.001$), internet connectivity ($\beta = 0.291, p < 0.001$), and technological devices ($\beta = 0.247, p < 0.001$). Educator competencies emerged as the strongest predictor, reinforcing that human capacity development yields greater impact on curriculum continuity than hardware provision alone. The model's explanatory power (69.9%) indicates substantial practical significance for policy and practice, suggesting that comprehensive interventions addressing all three components would substantially improve curriculum continuity during emergencies.

Discussions

The study found critically inadequate remote learning infrastructure across Kaduna state educational institutions, with mean scores below adequacy benchmarks for device availability ($M = 2.08$), internet connectivity ($M = 2.24$), and technical support systems ($M = 2.03$). This finding reveals systemic deficiencies that severely constrain emergency remote teaching capacity. This finding is supported by Oni et. al. (2025); Ramesh, Vasudevan and Oyedele (2024); Bashir et. al. (2021) findings, identifying

insufficient infrastructure, limited device access, and poor internet connectivity as primary barriers to educational technology adoption. The study emphasized that the digital divide perpetuates educational inequalities, with rural and economically disadvantaged communities disproportionately affected. However, contrary perspectives emerge from Yinusa (2025); World Bank (2024) who reported significant digitization progress in Kaduna state's education sector through UNICEF collaboration, including establishment of digital dashboards, real-time monitoring systems, and enhanced Education Management Information Systems across over 8,000 schools.

The study revealed low levels of curriculum continuity during emergencies, with particular challenges in achievement of learning outcomes, adaptation to learner needs, and maintenance of learning pace. These findings indicate that infrastructure inadequacies translate directly into pedagogical challenges compromising educational quality. This finding aligns with Ikwuka (2021); Landa et. al. (2021); TEP Centre (2020) research cited by Amorighoye (2020) showing that 28% of Nigerian teachers reported students were not actively learning during the COVID-19 pandemic due to inaccessibility of digital learning tools. The widespread inability to maintain learning continuity reflects systemic failures in emergency preparedness and response mechanisms. Similarly, UNICEF (2022) documentation of school closures in northern Nigeria noted that over 618 schools closed due to security threats resulted in significant learning losses extending over two months, demonstrating how multiple emergency types (health, security) compound curriculum continuity challenges. Conversely, UNICEF (2024); World Bank (2024) documentation of learning continuity strategies in some African contexts revealed successful implementation of alternative modalities including radio programs, SMS dissemination, and targeted distribution of learning materials, which maintained educational engagement during crises. These creative distance teaching approaches developed during COVID-19 proved scalable to other emergency situations, suggesting that curriculum continuity is achievable when appropriate adaptations are implemented.

The study established significant positive relationships between technological device availability, internet connectivity, educator digital competencies, and curriculum continuity outcomes. The multiple regression model showed that these components collectively predict 69.9% of curriculum continuity variance, with educator competencies being the strongest predictor. This finding is strongly supported by Miller (2025); Shittu et. al. (2023); Abass et. al. (2021); UNESCO (2021) research demonstrated

that perceived usefulness, ease of use, and behavioral intentions significantly influence technology adoption for learning in Nigeria, with their model explaining 61% of acceptance variance. The parallel explanatory power suggests that both infrastructure provision and user acceptance factors critically determine educational technology effectiveness. However, Landa et. al. (2021) noted that despite some South African universities providing technological resources and zero-rated educational applications during COVID-19, many rural students still could not effectively access online learning due to socioeconomic constraints, electricity shortages, and digital literacy gaps. This indicates that the infrastructure-continuity relationship is moderated by contextual factors including socioeconomic status, geographic location, and broader systemic conditions, potentially weakening direct correlations in highly disadvantaged contexts.

The study found that while educators possess basic computer skills, they lack specialized competencies in online teaching platforms, digital content creation, and emergency remote teaching pedagogy. Notably, educator competencies showed the strongest correlation with curriculum continuity, indicating human capacity development is paramount. This finding is strongly supported by Miller (2025); UNICEF (2024); Shittu et. al. (2023) research emphasizing teacher professional development as a critical strategy for strengthening learning continuity during emergencies. The research advocated for training teachers in vocational and life-skills education, emotional resilience, innovative teaching methods, dynamic curriculum adaptation, and crisis management all competencies identified as deficient in the present study. However, Oni et. al. (2025); Bashir et. al. (2021) found that even technologically competent educators could not effectively deliver remote instruction when students lacked devices, internet access, or electricity, indicating that competencies alone cannot compensate for severe infrastructure deficits.

Conclusion

Remote learning infrastructure plays a vital role in ensuring curriculum continuity during periods of emergencies among education stakeholders in Kaduna state. Emergencies such as pandemics, conflicts, natural disasters, and school closures often disrupt the normal teaching and learning process. However, the availability and effective use of remote learning facilities such as internet connectivity, digital devices, learning management systems, radio and television educational programmes can help minimize learning disruptions and sustain academic activities.

For education stakeholders, including teachers, students, school administrators, and government agencies, the adoption of remote learning strategies provides an alternative platform for delivering and accessing instructional content. It enables teachers to continue lesson delivery, maintain communication with students, and monitor learners' progress even when physical classrooms are inaccessible. At the same time, students are given the opportunity to remain engaged in academic activities, thereby preventing learning loss and ensuring that the curriculum is implemented as planned.

Nevertheless, the effectiveness of remote learning infrastructure depends on several factors such as availability of technological resources, digital literacy of teachers and students, reliable electricity supply, and supportive educational policies. In Kaduna state, addressing challenges such as inadequate ICT facilities, limited internet access in rural areas, and insufficient training for educators is essential for strengthening remote learning systems. Therefore, government, educational institutions, and other stakeholders must invest in sustainable digital infrastructure, provide adequate training for teachers, and develop flexible curriculum delivery strategies that can function effectively during emergencies. By doing so, the education system in Kaduna state will be better prepared to maintain curriculum continuity and ensure that learning remains uninterrupted regardless of unforeseen crises.

Recommendations

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

1. That Kaduna state Government should substantially increase budgetary allocation for educational technology infrastructure, prioritizing procurement and distribution of devices (tablets, laptops) to schools, particularly in rural and underserved areas. Investment should encompass not only hardware but also renewable energy solutions (solar power systems) to address electricity supply challenges that undermine technology utilization.
2. Efforts should be intensified to collaborate with telecommunications providers to establish affordable, reliable internet connectivity in all educational institutions. This could include negotiated zero-rated educational content access, subsidized data plans for educators and learners, installation of school-based WiFi systems, and exploration of alternative connectivity solutions such as community learning hubs with shared internet access.

3. Ministry of Education should endeavour to implement mandatory and professional development programmes to equip educators with emergency remote teaching competencies. Such training should encompass online platform utilization, digital content creation, online assessment methodologies, learner engagement strategies in virtual environments, and adaptive pedagogy for diverse emergency contexts.

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