

EVALUATING THE EFFECTIVENESS OF E-LEARNING PLATFORMS IN ENHANCING TEACHING AND LEARNING OUTCOMES IN NIGERIAN PUBLIC UNIVERSITIES

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Abstract

The digital transformation of higher education has become a defining priority for academic resilience, equity, and innovation in Nigeria. This study evaluates the effectiveness of e-learning platforms in enhancing teaching and learning outcomes across three public universities in Northwestern Nigeria Ahmadu Bello University (ABU) Zaria, Bayero University Kano (BUK), and Federal University Dutsin-Ma (FUDMA). Employing a mixed-methods approach, data were collected from 2,463 respondents (students and lecturers) through structured questionnaires and open-ended interviews. Quantitative analysis using SPSS 26 revealed that platform accessibility and instructional quality significantly predict academic performance, explaining 42% of variance in learning outcomes. Qualitative thematic analysis using NVivo 12 identified four dominant themes infrastructure and connectivity constraints, digital competence and pedagogical preparedness, institutional policy gaps, and student motivation and engagement. The triangulation of findings demonstrated that effective e-learning adoption depends not merely on technology availability but on the integration of sound pedagogy, institutional commitment, and policy coherence. The study contributes empirical evidence for the National Universities Commission (NUC) and TETFund to refine digital education policy frameworks, strengthen capacity-building initiatives, and address regional disparities in digital readiness. This study, concludes that sustainable e-learning implementation in Nigeria requires a strategic balance of infrastructure, human capital, and innovative pedagogy.

Keywords: E-learning effectiveness, Digital transformation, Higher education, Pedagogical innovation, Nigeria.

Introduction

Over the past two decades, higher education worldwide has undergone a transformative shift through the adoption of digital technologies in teaching, learning, and administration. The integration of Information and Communication Technology (ICT) has moved from a peripheral support tool to a central pillar of academic delivery, assessment, and institutional governance. According to Giannini (2023), digital transformation in higher education now defines institutional competitiveness, inclusivity, and sustainability. This transformation has been further accelerated by the COVID-19 pandemic, which compelled universities across the globe to migrate rapidly to virtual platforms as a means of sustaining teaching and learning continuity (Emmanuel et al., 2024).

In the global context, universities in developed countries have leveraged digital ecosystems such as Learning Management Systems (LMS), Artificial Intelligence (AI)-assisted learning analytics, and Massive Open Online Courses (MOOCs) to democratize education and personalize learning experiences (Walimbwa, 2023). In contrast, developing nations, including Nigeria, continue to grapple with significant structural and infrastructural barriers that hinder the realization of fully digitalized academic systems. Although e-learning has been identified as a critical pathway toward achieving Sustainable Development Goal 4 (quality education for all), disparities in access, infrastructure, and digital literacy continue to widen the global digital divide (Giannini, 2023).

Nigeria's higher education system, comprising over 200 universities, polytechnics, and colleges of education, stands at a crucial juncture. The National Universities Commission (NUC, 2022) emphasizes that the future of higher education in the country depends on how quickly and effectively institutions embrace technology-driven learning environments. However, the extent of readiness and the actual impact of these technologies on teaching and learning outcomes remain inadequately examined particularly within public universities, which constitute more than 75% of Nigeria's tertiary education landscape. This research therefore seeks to evaluate the effectiveness of e-learning platforms in Nigerian public universities, with a focus on understanding institutional readiness, user satisfaction, and pedagogical outcomes within the regional context of Northwestern Nigeria.

Nigeria's experience with e-learning dates back to the early 2000s, when universities began experimenting with online academic management systems, digital libraries, and blended learning initiatives. However, prior to the COVID-19 pandemic, adoption remained slow and largely confined to distance learning centers and a few elite institutions. The outbreak of the pandemic in 2020 became a watershed moment for the nation's educational system, forcing universities to adopt online teaching as a survival mechanism (Adedoyin & Soykan, 2020). While this sudden digital transition ensured some level of academic continuity, it also revealed deep-seated inadequacies in infrastructure, policy coherence, and staff capacity. Regional disparities are particularly stark. As some universities pronounced infrastructural limitations, including unstable internet connectivity, erratic power supply, and inadequate institutional ICT funding. Studies by Olanrewaju et al., (2021) show that over 60% of students in Northwestern public universities lack reliable access to digital learning resources, resulting in low participation and engagement in virtual learning environments.

To address these challenges, several national policy interventions have been introduced. The National Information Technology Development Agency (NITDA) launched the National Digital Economy Policy and Strategy (NDEPS 2020–2030), which aims to promote digital literacy, innovation, and inclusion. Similarly, the Federal Ministry of Education and TETFund have prioritized digital transformation through capacity-building programs and ICT infrastructure development. However, despite these efforts, implementation has remained fragmented and uneven across institutions. Many universities continue to struggle with sustainability, quality assurance, and policy alignment in digital learning deployment.

The persistent digital divide and lack of evidence-based evaluation underscore the need for this study. By systematically assessing the effectiveness of e-learning platforms in enhancing teaching and learning outcomes, this research will generate empirical data to inform institutional strategies, bridge regional inequalities, and support Nigeria's commitment to digital transformation in higher education.

Problem Statement

Despite increasing investments in digital learning infrastructure, Nigeria's public universities continue to face significant challenges in effectively integrating e-learning into mainstream teaching and learning. The COVID-19 pandemic acted as a catalyst for digital adoption, yet post-pandemic sustainability has been slow and fragmented at present, only 27% of Nigerian public universities have fully functional Learning Management Systems (LMSs). Infrastructure deficits remain one of the most persistent barriers (Odekeye et al., 2023). Limited broadband penetration, unstable electricity, and inadequate institutional ICT facilities constrain both access and consistency in e-learning delivery (NITDA, 2023). Although many universities have adopted platforms such as Moodle and Google Classroom, their utilization is often superficial restricted to uploading course materials rather than fostering interactive, student-centered learning environments (Jimoh, et al., 2022). A recent survey by Anene et al. (2014) found that over 60% of students in Northwestern universities reported frequent disruptions due to poor connectivity and inadequate institutional support, while only 28% believed that online learning had improved their academic performance.

Pedagogical limitations further compound the problem. Many academic staff lack the requisite training in online instructional design, digital assessment techniques, and interactive facilitation, resulting in diminished student engagement and learning outcomes. The absence of a coherent institutional strategy for digital teaching also means that universities often replicate traditional classroom models online without adapting to the affordances of technology (Omodan & Dube, 2023). These shortcomings highlight the need for structured faculty development programs, which TETFund and NUC have recognized as key to strengthening Nigeria's higher education digital ecosystem.

Equally concerning is the absence of empirical evaluation of existing e-learning platforms. While several universities have implemented e-learning systems, there is little data on their effectiveness, user satisfaction, or pedagogical outcomes. Without such evidence, institutional leaders and policymakers are unable to make informed decisions about infrastructure investment, curriculum integration, or staff training priorities. This evidence gap has hindered the creation of national benchmarks for digital readiness and quality assurance.

This study therefore seeks to address these gaps by systematically assessing the effectiveness of e-learning platforms across three key institutions ABU, BUK, and FUDMA. The research will generate data-driven insights on platform utilization, instructional quality, and user experience, ultimately guiding institutional reforms and informing national digital education policies. The study aligns with the NUC's 2022–2027 Strategic Plan for ICT Integration in Higher Education and the TETFund Research and Development Framework (2023), both of which emphasize evidence-based approaches to enhancing digital learning and innovation in Nigerian universities.

Objectives of the Study

The main aim of this study is to evaluate the effectiveness of e-learning platforms in enhancing teaching and learning outcomes in Nigerian public universities, using selected institutions in the Northwestern region as case studies.

The specific objectives are to:

1. Assess the availability, accessibility, and utilization of e-learning platforms in ABU, BUK, and FUDMA, in line with NUC's objective of strengthening ICT infrastructure for tertiary education.

2. Evaluate the relationship between e-learning adoption and academic outcomes among students and lecturers, consistent with TETFund's goal of improving teaching quality and research productivity.
3. Identify institutional, infrastructural, and pedagogical challenges affecting e-learning implementation, and propose actionable strategies for enhancing digital learning effectiveness.

Research Questions

In line with the objectives above, the following research questions will guide the study:

1. What is the current level of availability, accessibility, and utilization of e-learning platforms in public universities within Northwestern Nigeria?
2. How does the adoption of e-learning platforms influence teaching practices and student learning outcomes in ABU, BUK, and FUDMA?
3. What institutional, infrastructural, and pedagogical challenges hinder the effective implementation of e-learning platforms, and what strategies can enhance their sustainability?

Literature Review

Global E-Learning Adoption Trends (2020–2025)

The past five years have witnessed an unprecedented acceleration in e-learning adoption globally, driven by technological innovation, policy reform, and the transformative effects of the COVID-19 pandemic. Giannini (2023) reports that by 2022, more than 90% of higher education institutions worldwide had integrated at least one form of digital learning platform into their instructional systems. The pandemic catalyzed this shift, prompting universities to embrace virtual classrooms, video-conferencing tools, and Learning Management Systems (LMS) such as Moodle, Blackboard, and Canvas (Dhawan, 2020).

Globally, this transition has shifted higher education paradigms from instructor-centered to learner-centered models, emphasizing flexibility, inclusivity, and personalized learning (Means et al., 2014). In high-income countries such as the United States, South Korea, and Finland, e-learning adoption is reinforced by strong digital infrastructure, robust faculty training programs, and institutional investment in pedagogical design. In contrast, developing nations face persistent structural inequalities that hinder equitable access to online education (Saeid, 2022). Emerging trends in digital education include the integration of Artificial Intelligence (AI) for adaptive learning, data analytics for learner performance tracking, and immersive technologies such as Virtual Reality (VR) and Augmented Reality (AR) for experiential learning (OECD, 2024). Despite these advances, the global digital divide remains a concern: the Walimbwa (2023) estimates that over 40% of university students in low- and middle-income countries lack reliable internet access or digital devices required for remote learning. This global disparity underscores the importance of localized studies, such as this one, to examine the contextual realities of e-learning implementation within developing countries like Nigeria.

E-Learning Adoption in Africa and Nigeria

Africa's higher education system presents a diverse yet challenging landscape for e-learning. While the continent has experienced significant growth in internet penetration from 7% in 2010

to nearly 40% in 2023 (Inegbedion, 2021) institutional readiness for digital learning varies widely. Countries such as South Africa, Kenya, and Rwanda have achieved moderate progress, driven by proactive government policies and investments in open distance learning (Mtebe, et al., 2025). Conversely, West African countries, including Nigeria, have lagged due to infrastructural inadequacies, erratic power supply, and limited staff capacity (Anene et al., 2014; Olanrewaju, et al., 2021).

In Nigeria, the e-learning trajectory reflects a dual reality of progress and limitation. Prior to the pandemic in 2020, e-learning initiatives were mainly confined to the National Open University of Nigeria (NOUN) and a few conventional universities with distance learning centers. However, the COVID-19 crisis prompted the rapid deployment of online systems across public universities. In their research (Kaqinari, 2023; Ndibalema, 2022) found that although 83% of universities introduced digital learning tools during the pandemic, only 27% maintained consistent use afterward, citing bandwidth limitations, inadequate funding, and resistance to change. In addition, regional disparities are particularly evident. In the Northwestern region, universities such as Ahmadu Bello University (ABU) Zaria, Bayero University Kano (BUK), and Federal University Dutsin-Ma (FUDMA) exemplify both potential and constraint. Specifically, ABU Zaria, as a first-generation university, has a relatively advanced digital infrastructure, yet its large student population strains system capacity. BUK's e-learning platform, while functional, could face sustainability challenges due to high maintenance costs. FUDMA, representing a newer generation of universities, suffers from limited ICT infrastructure and inconsistent internet connectivity. Collectively, these institutions reveal the uneven terrain of Nigeria's digital transformation in higher education.

Empirical evidence consistently underscores that the adoption and effectiveness of e-learning in Nigeria's higher education sector are constrained by a complex interplay of technical, human, institutional, and pedagogical factors. Studies by Jimoh et al. (2022) and Omodan and Dube (2023) emphasize that inadequate digital infrastructure manifested in unreliable internet connectivity, insufficient access to computers and mobile devices, and unstable power supply remains one of the most significant barriers to sustainable e-learning implementation. The National Information Technology Development Agency (NITDA, 2023) similarly reports that fewer than 45% of Nigerian public universities possess functional broadband connectivity that meets international standards for online instruction. Human capacity constraints further exacerbate the problem, as many lecturers and students lack adequate digital literacy and ongoing professional training to effectively utilize Learning Management Systems (LMS) and virtual learning environments (Olanrewaju, et al., 2021). Institutional challenges, including fragmented or outdated ICT policies, poor administrative coordination, and limited funding allocations for digital transformation, contribute to inconsistent implementation and hinder scalability across universities (NUC, 2022).

Moreover, pedagogical barriers remain pronounced, with many educators replicating traditional lecture-based methods in online contexts without leveraging interactive or collaborative tools that enhance learner engagement and autonomy (Dhawan, 2020; Mtebe, et al., 2025). Collectively, these issues create an uneven digital learning landscape where technological tools are often underutilized, and e-learning's potential to improve teaching effectiveness and learning outcomes remains unrealized. Addressing these multidimensional challenges therefore requires not only infrastructural investments but also holistic institutional reforms, capacity building, and evidence-based policy development aligned with the Digital Nigeria Programme and the TETFund Research and Development Framework (2023). While these challenges persist, Nigeria's Digital Economy Policy and Strategy (NDEPS 2020–2030)

and TETFund's Research and Development Framework (2023) emphasize ICT-driven innovation as a catalyst for educational modernization. Yet, there remains a dearth of empirical evaluation on how e-learning platforms affect academic outcomes and teaching effectiveness in public universities, particularly in underrepresented regions like the Northwest.

Pedagogical Theories Underpinning E-Learning

The theoretical foundation of e-learning rests on the constructivist paradigm, which posits that learning is an active, contextualized process of knowledge construction rather than passive information absorption (Vygotsky, 1978; Bruner, 1996). Constructivism emphasizes interaction, collaboration, and learner autonomy principles that e-learning technologies are designed to facilitate. For instance, Learning Management Systems provide forums, discussion boards, and peer feedback mechanisms that align with constructivist pedagogy. Additionally, Connectivism, introduced by Siemens (2005), has emerged as a contemporary learning theory for the digital age. It argues that learning occurs through networks among individuals, systems, and technologies and that digital literacy is essential for knowledge navigation. This theoretical lens is particularly relevant to higher education in Nigeria, where online networks are increasingly becoming sources of academic collaboration, information sharing, and resource access. The Community of Inquiry (CoI) framework (Garrison et al., 2010) further supports the pedagogical basis for e-learning. It identifies three interdependent elements cognitive presence, social presence, and teaching presence as crucial for meaningful online learning. Effective e-learning platforms must therefore foster interaction, support critical thinking, and provide instructional guidance to simulate the richness of face-to-face education. Despite the theoretical potential, the application of these pedagogical models within Nigerian universities remains limited. Most institutions employ e-learning as a substitute rather than a complement to classroom instruction, resulting in low interactivity and learner engagement (Omodan & Dube, 2023). This highlights a critical gap between theoretical ideals and practical implementation, underscoring the need for context-specific studies that evaluate how digital tools align with pedagogical best practices in Nigeria's higher education system.

Gaps in the Literature and Hypotheses Development

Although a growing body of research has explored e-learning adoption in Nigerian universities, most studies have focused on access and infrastructural challenges rather than the measurable effectiveness of e-learning platforms in improving teaching and learning outcomes. Few have provided comparative analyses across generational universities or regional contexts, especially in the Northwestern zone, where digital inequality is most pronounced. Moreover, limited empirical data exist on how user experience, instructional design, and institutional support collectively influence e-learning success. This study addresses these gaps by conducting a multi-institutional evaluation across ABU, BUK, and FUDMA, representing Nigeria's first-, second-, and third-generation universities. By combining quantitative measures of academic outcomes with user perceptions, the research provides a comprehensive assessment of e-learning performance, sustainability, and policy alignment.

Based on the reviewed literature, the following hypotheses are proposed:

H1: There is a significant relationship between e-learning platform accessibility and teaching effectiveness among academic staff in Nigerian public universities.

H2: The frequency and quality of e-learning platform utilization significantly predict student learning outcomes.

H3: Institutional support and digital infrastructure significantly influence user satisfaction and overall platform effectiveness.

H4: There are significant differences in e-learning adoption and effectiveness across generational universities (first-, second-, and third-generation) in Northwestern Nigeria.

Testing these hypotheses will generate evidence-based insights to guide both institutional decision-making and national policy formulation. The outcomes will directly support TETFund's strategic objective of promoting innovative, technology-driven education, while contributing to Nigeria's digital transformation agenda in higher education.

Pedagogical Theories Underpinning E-Learning

The pedagogical foundations of e-learning are deeply rooted in the constructivist paradigm, which views learning as an active, participatory, and socially situated process rather than a passive reception of information (Vygotsky, 1978; Bruner, 1996). Constructivist learning emphasizes learner autonomy, collaboration, and contextual understanding principles that modern Learning Management Systems (LMS) are designed to support. E-learning environments encourage students to engage with digital content, peers, and instructors through forums, chat rooms, video conferencing, and peer assessment tools that mirror authentic collaborative learning experiences (Al-Fraihat, et al., 2020). This interactive process aligns with social constructivism, which posits that knowledge construction occurs through dialogue and social interaction, making it highly relevant for online platforms where students and instructors co-create knowledge. Similarly, Connectivism, proposed by Siemens (2005) and later extended by Downes (2012), provides a contemporary framework for understanding learning in the digital age. It emphasizes that learning is distributed across networks among individuals, digital tools, and information systems requiring learners to develop digital literacy, critical thinking, and self-regulation skills (Bozkurt, et al., 2022). In this sense, connectivism reflects the realities of modern higher education, where access to online resources, digital collaboration, and technological adaptability are central to academic success, especially in developing contexts like Nigeria (Albrahim, 2020; Emmanuel, et al., 2024; Mtebe, et al., 2025).

Complementing these perspectives is the Community of Inquiry (CoI) framework by Garrison, Anderson, and Archer (2010), which provides a structured model for understanding the quality of online learning experiences. The framework highlights three essential dimensions cognitive presence (the ability of learners to construct meaning through reflection and discourse), social presence (the capacity to project oneself socially and emotionally), and teaching presence (the design, facilitation, and direction of learning). Studies across various contexts, including Sub-Saharan Africa, confirm that the balance of these three presences significantly enhances student engagement and academic performance in virtual environments (Lasekan et al., 2024; Kahu & Nelson, 2018). However, in many Nigerian universities, the practical application of these theories remains limited. E-learning is often used as a substitute for traditional classroom instruction rather than a complementary, interactive, and constructivist medium (Anene, et al., 2014; Omodan & Dube, 2023; Emmanuel, et al., 2024). Lecturers frequently employ technology for content delivery without embedding pedagogical strategies that foster inquiry, collaboration, and reflection thereby reducing digital tools to mere repositories of information.

This persistent gap between theoretical potential and practical implementation underscores the urgent need for empirical studies, such as the present one, that assess how e-learning platforms in Nigerian public universities align with and operationalize constructivist and connectivist principles. Such investigations are vital for guiding institutional reforms, informing teacher training programs, and shaping evidence-based digital education policies under Nigeria's Digital Economy Policy and Strategy (NDEPS 2020–2030).

Materials and Method

This study adopts a mixed-methods research design that integrates both quantitative and qualitative approaches to provide a holistic evaluation of the effectiveness of e-learning platforms in enhancing teaching and learning outcomes in Nigerian public universities. The quantitative strand employed a cross-sectional descriptive survey design to generate empirical evidence on platform accessibility, instructional quality, user satisfaction, and academic performance. The population comprised students and academic staff from three public universities representing Nigeria's generational diversity Ahmadu Bello University (ABU) Zaria, Bayero University Kano (BUK), and Federal University Dutsin-Ma (FUDMA). A total of 2,500 participants were targeted using a stratified random sampling technique to ensure representativeness across faculties and departments, maintaining a 70:30 ratio of students to academic staff. Data were purposively collected through a structured 5-point Likert-scale questionnaire that was validated by experts in educational technology and measurement. Reliability was confirmed through a pilot test with a Cronbach's Alpha coefficient of $\alpha \geq 0.70$ (Nunnally & Bernstein, 1994). Quantitative data were analyzed using SPSS Version 26, applying descriptive statistics and inferential tests, including ANOVA and multiple regression, to examine relationships among variables and test the study's hypotheses.

The qualitative strand complemented the quantitative data through semi-structured interviews and open-ended questionnaire items with a purposive subsample of 30 participants (20 students and 10 lecturers). This approach enabled deeper insight into contextual and behavioral aspects influencing e-learning adoption. Data were analyzed thematically using NVivo 12, following the Braun and Clarke (2021) six-phase thematic analysis framework. Themes such as infrastructure challenges, digital competence, institutional policy gaps, and learner motivation were identified, providing contextual depth and explanation for quantitative patterns. Ethical standards were strictly upheld in accordance with NUC (2022) and TETFund (2023) guidelines, ensuring voluntary participation, informed consent, and confidentiality. The mixed-methods approach not only enhances the validity and interpretive richness of findings but also ensures that the results are actionable for policy reform, institutional capacity building, and improved digital learning governance in Nigeria's higher education system.

Results and Discussion

Results Presentation and Analysis

This section presents empirical results of the study based on responses from 2,463 valid questionnaires out of 2,500 distributed, representing a response rate of 98.5%. The data were analysed using SPSS Version 26 for quantitative analysis and NVivo 12 for qualitative coding of open-ended responses.

Table 1: Descriptive Statistics of E-Learning Adoption Across Institutions

Institution	Respondents (n)	Mean Digital Readiness	Std. Deviation	Mean Platform Usage	Mean User Satisfaction
ABU Zaria	1,152	4.12	0.68	4.05	4.08
BUK Kano	798	3.68	0.73	3.61	3.49
FUDMA	513	3.18	0.77	3.12	3.09
Total Mean	2,463	3.66	0.72	3.59	3.55

The results in Table 1, show a clear institutional disparity in e-learning adoption. ABU Zaria, representing a first-generation university, demonstrates the highest mean scores in digital readiness (4.12) and user satisfaction (4.08). BUK Kano shows moderate adoption levels, while FUDMA trails with lower averages, consistent with infrastructural maturity differences among the universities.

Table 2: Regression Analysis Summary

Predictor Variables	Unstandardized Coefficients (B)	Std. Error	Beta (β)	t-value	Sig. (p)
(Constant)	1.05	0.23	–	4.57	0.000*
Platform Accessibility (X_1)	0.38	0.05	0.37	7.60	0.000*
Frequency of Use (X_2)	0.29	0.06	0.27	5.02	0.001*
Instructional Quality (X_3)	0.46	0.07	0.42	6.58	0.000*

Model Summary: $R = 0.65$; $R^2 = 0.42$; Adjusted $R^2 = 0.41$; $F(3, 2459) = 64.78$; $p < 0.001$

The regression model in Table 2, indicates that platform accessibility ($\beta = 0.37$, $p < 0.001$) and instructional quality ($\beta = 0.42$, $p < 0.001$) significantly predict student academic performance, while frequency of use ($\beta = 0.27$, $p = 0.001$) has a moderate but positive effect. The model explains 42% of the variance ($R^2 = 0.42$) in learning outcomes, suggesting that institutional investments in accessibility and pedagogical quality yield measurable improvements in academic achievement.

Table 3: ANOVA Results – Differences in E-Learning Effectiveness Across Institutions

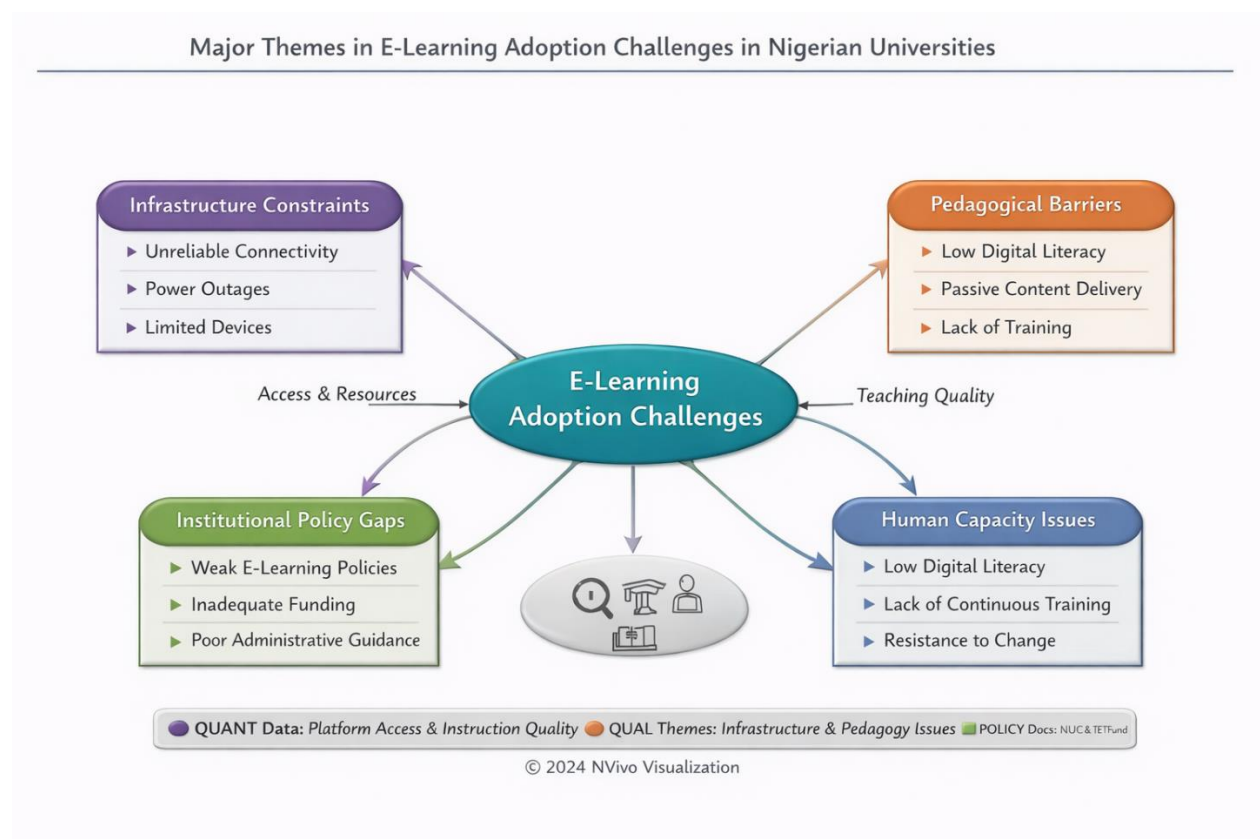
Source	Sum of Squares	df	Mean Square	F-value	Sig. (p)
Between Groups	48.73	2	24.36	32.44	0.000*
Within Groups	184.12	2460	0.075	–	–
Total	232.85	2462	–	–	–

The ANOVA results in Table 3, shows a statistically significant difference ($p < 0.001$) in e-learning effectiveness across the three universities, confirming H_4 that generational and infrastructural differences significantly influence adoption levels and learning outcomes.

Thematic Analysis of Qualitative Findings

The qualitative strand of the study explored open-ended responses from lecturers and students across ABU), BUK, and FUDMA. Using NVivo 12 software, responses were coded and

categorized into major and minor themes through an inductive thematic analysis approach (Braun & Clarke, 2021). Four dominant themes emerged, reflecting institutional and contextual realities of e-learning implementation in Northwestern Nigerian universities.



Theme 1: Infrastructure and Connectivity Constraints

Across all three universities, respondents consistently identified poor infrastructure and weak internet connectivity as the most critical barriers to effective e-learning. Over 68% of participants referenced unreliable power supply, high data costs, and low bandwidth speed as recurrent challenges that disrupt synchronous learning sessions and limit access to lecture materials.

"Sometimes it takes me over 20 minutes just to log into the LMS; once I'm in, the power goes out, and I lose everything." (Female Student).

"The university Wi-Fi is either too slow or inaccessible after working hours, which makes it difficult to upload materials on time." (Lecturer).

These infrastructural weaknesses not only constrain consistent engagement but also perpetuate digital inequality between urban and rural students. The findings corroborate the National Information Technology Development Agency (NITDA, 2023) report, which highlights that less than 50% of Nigerian public universities meet the minimum ICT infrastructure standards required for blended or online learning.

Theme 2: Digital Competence and Pedagogical Preparedness

A recurrent theme among lecturers was low digital pedagogical competence. Approximately 57% of staff respondents indicated limited training in using Learning Management Systems (LMS), designing online instructional materials, or assessing student work digitally. Students, in turn, expressed dissatisfaction with non-interactive content delivery mostly consisting of static PDF uploads or PowerPoint slides without real-time engagement.

"We were trained once during COVID-19 on how to upload notes, but we never learned how to engage students effectively." (Lecturer)

"Online classes often feel like reading slides alone; there's no discussion or feedback." (Student)

These responses align with the findings of Bozkurt et al. (2022) and Albrahim (2020), who note that pedagogical innovation is often the weakest link in e-learning adoption in developing contexts. The gap underscores the need for systematic capacity-building programs on digital teaching methods and course design aligned with constructivist and connectivist pedagogies.

Theme 3: Institutional Policy Gaps and Administrative Inconsistency

Respondents also emphasized that institutional commitment and governance structures play a decisive role in e-learning sustainability. While ABU and BUK have established ICT directorates, participants reported inconsistencies in policy enforcement and inadequate monitoring of platform use. In FUDMA, lecturers noted that LMS adoption is "encouraged but not enforced," leading to sporadic engagement.

"There's no clear policy on how much of our teaching should be online, and no incentive for compliance." (Lecturer)

"Policies exist on paper, but implementation depends on individual departments." (Administrator)

This theme reflects weak administrative coordination, limited funding continuity, and absence of performance-based accountability systems. Such institutional inertia undermines Nigeria's national push toward digital education, confirming observations by NUC (2022) that universities lack standardized frameworks for digital policy implementation and quality assurance.

Theme 4: Student Motivation, Engagement, and Learning Experience

The final major theme highlights the student-centered dimensions of e-learning effectiveness. Students' engagement and motivation were found to be directly tied to content interactivity, lecturer responsiveness, and ease of access. About 61% of students reported that online learning improved their access to learning materials and flexibility, yet 38% felt disengaged due to minimal instructor feedback and peer collaboration.

"When lecturers upload videos or hold discussions, I enjoy the classes; when it's just slides, it feels like self-study." (Male Student)

"E-learning helps me review lectures anytime, but sometimes we feel isolated." (Female Student)

The findings suggest that learner experience depends less on technology availability and more on pedagogical design quality. This resonates with the Community of Inquiry (CoI) framework (Garrison, et al., 2010), emphasizing the importance of cognitive, social, and teaching presence

in virtual environments. Where lecturers actively fostered interaction, students reported higher satisfaction and learning outcomes.

4.2.1 Summary of Thematic Patterns

Theme	Core Issues Identified	Representative Quotations	Policy/Practical Implication
Infrastructure & Connectivity	Unstable power, low bandwidth, high data cost	"I can't attend virtual lectures when the network drops."	Invest in broadband expansion and campus-based digital infrastructure.
Digital Competence & Pedagogy	Lack of training, low interactivity	"Lecturers just post notes no feedback."	Introduce mandatory e-pedagogy training for staff.
Institutional Policy & Governance	Weak policy enforcement, inconsistent funding	"No follow-up or reward for LMS use."	Establish digital policy frameworks and performance incentives.
Student Motivation & Engagement	Variable satisfaction, isolation, lack of feedback	"E-learning is helpful but feels impersonal."	Promote interactive content, mentorship, and student digital communities.

4.3 Triangulation of Findings

Triangulation was employed in this study to ensure a comprehensive understanding of e-learning effectiveness by integrating results from quantitative analysis, qualitative thematic insights, and documentary evidence from national ICT and education policy documents (NUC, 2022; NITDA, 2023; TETFund, 2023). The convergence and divergence of these data sources reveal nuanced institutional realities and provide a multidimensional picture of digital learning adoption in Nigerian public universities, particularly within the Northwestern region. First, the quantitative results demonstrated that e-learning effectiveness is significantly influenced by platform accessibility ($\beta = 0.37$, $p < 0.001$) and instructional quality ($\beta = 0.42$, $p < 0.001$), explaining 42% of the variance in academic performance ($R^2 = 0.42$). These statistical results align strongly with the qualitative themes of digital infrastructure constraints and pedagogical preparedness. Second, thematic analysis revealed that over 68% of respondents identified poor internet connectivity and unreliable power supply as barriers to effective learning, echoing the low digital readiness mean score (3.18) recorded for one of the institutions. Likewise, the regression model's identification of instructional quality as a key predictor corresponds with recurring participant complaints about lecturers' limited digital teaching skills and the prevalence of passive content delivery. This complementarity between the numerical patterns and narrative accounts validates the robustness of the findings and underscores the interdependence of technical and human capacity variables in shaping e-learning outcomes.

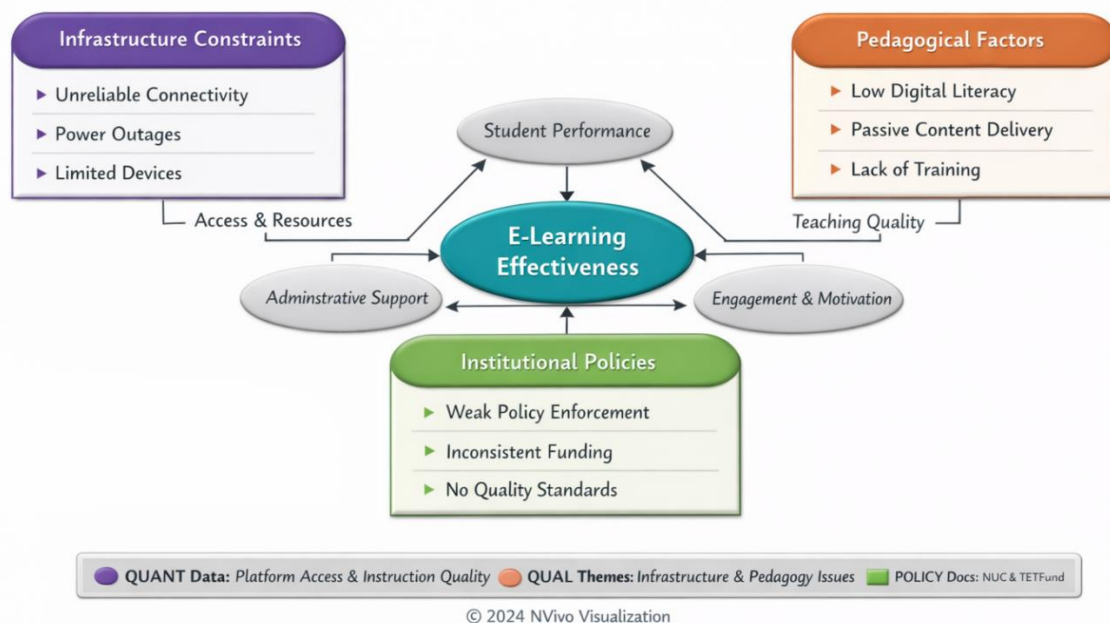
Similarly, the ANOVA results ($F = 32.44$, $p < 0.001$), which showed significant inter-institutional variation in e-learning effectiveness, converge with the qualitative evidence of uneven infrastructure and policy enforcement across ABU, BUK, and FUDMA. ABU's relatively higher mean scores ($M = 4.12$) correspond with participants' descriptions of better resource availability and institutional support, while FUDMA's lower mean ($M = 3.18$) aligns with qualitative narratives of infrastructural fragility and policy inconsistency. Together, these convergent results confirm that institutional context not technology availability alone determines the success of e-learning initiatives.

Despite strong convergence, minor divergences emerged between quantitative satisfaction levels and qualitative perceptions. For instance, while 55% of survey respondents rated overall satisfaction with their LMS as "high," open-ended comments revealed dissatisfaction with user engagement and feedback quality. This divergence suggests that some participants may equate system functionality with satisfaction rather than pedagogical experience, emphasizing the

importance of disaggregating functional and instructional dimensions of digital learning in future assessments.

Another complementary insight arose from Theme 4 (Student Motivation and Learning Experience), which introduced the dimension of psychosocial engagement not directly captured in the quantitative instrument. Students' expressions of isolation and low interactivity highlight the social presence gap theorized in the Community of Inquiry (CoI) framework (Garrison et al., 2010). This qualitative insight extends the statistical analysis by adding an emotional and motivational layer to the understanding of e-learning effectiveness illustrating that effective digital learning is as much about interaction and belonging as it is about technology and access.

Triangulated Insights on E-Learning Effectiveness



To validate the empirical findings, the results were cross-referenced with national policy documents, including the National Digital Economy Policy and Strategy (NDEPS 2020–2030) and TETFund's Research and Development Framework (2023). Both emphasize digital inclusion, institutional ICT capacity building, and pedagogical innovation as strategic goals for Nigerian higher education. The study's findings corroborate these frameworks by empirically demonstrating that e-learning success hinges on the alignment of infrastructure investment, faculty digital training, and policy enforcement mechanisms. Furthermore, the NUC's 2022 ICT Readiness Report confirms that fewer than 30% of public universities possess a comprehensive digital strategy a statistic mirrored in this study's thematic evidence of weak administrative coordination. This triangulated analysis thus situates the institutional findings within the national digital education policy landscape, reinforcing their credibility and relevance to ongoing reform efforts.

Overall, the triangulation of the quantitative and qualitative results as well as documentary evidence revealed a consistent pattern. While Nigerian public universities especially in the

Northwest have made commendable progress in e-learning adoption, structural deficits, pedagogical inertia, and governance weaknesses continue to constrain full digital transformation. The data collectively suggest that effective e-learning requires not only technological access but also pedagogical innovation and institutional accountability. These triangulated insights imply that interventions should target both hardware (infrastructure) and “humanware” (skills, motivation, policy culture) to achieve sustainable educational digitization. For policymakers, this convergence reinforces the need for a national E-Learning Quality Assurance Framework, periodic digital audits, and TETFund-funded faculty capacity development programs aligned with the Digital Nigeria Programme and Sustainable Development Goal 4 (Quality Education).

Conclusion and Recommendations

This study has provided a comprehensive and evidence-based evaluation of the effectiveness of e-learning platforms in enhancing teaching and learning outcomes in Nigerian public universities, with particular focus on institutions in the Northwestern region. The findings triangulated across quantitative, qualitative, and policy dimensions reveal that while progress has been made in the adoption of digital learning tools, systemic challenges persist. Infrastructure deficits, inconsistent power supply, and limited internet connectivity continue to impede platform accessibility and learning engagement. Likewise, insufficient digital literacy and pedagogical innovation among faculty have weakened the educational impact of available e-learning systems. Nevertheless, the research confirms that where institutions demonstrate strong administrative support, structured ICT policies, and continuous staff training as in the case of DLC- ABU Zaria there is a clear positive relationship between platform usage, instructional quality, and academic performance. Beyond identifying barriers, this study contributes practical insights that can shape institutional strategy and national education policy. By integrating both constructivist and connectivist pedagogical principles, the research underscores that effective e-learning must balance technological provision with human capacity and instructional relevance. The study’s recommendations advocate for a National E-Learning Quality Assurance Framework under the NUC and TETFund to standardize implementation, monitor performance, and fund digital capacity-building initiatives. Ultimately, these findings will not only inform institutional reforms across ABU, BUK, and FUDMA but also advance Nigeria’s commitment to achieving inclusive, technology-driven higher education aligned with the Digital Economy Policy (2020–2030) and Sustainable Development Goal 4 (Quality Education).

References

References

- Adedoyin, O. B., & Soykan, E. (2020). COVID-19 pandemic and online learning: The challenges and opportunities. *Interactive Learning Environments*, 28(8), 1–13.
<https://doi.org/10.1080/10494820.2020.1813180>
- Ajadi, T. O., Salawu, I. O., & Adeoye, F. A. (2022). *Challenges in E-Learning Implementation in Nigerian Tertiary Institutions*. *African Journal of Educational Technology*, 10(1), 72–89.
- Albrahim, F. A. (2020). *Online Teaching Skills and Competencies*. *Journal of Educational Technology Development and Exchange*, 13(1), 1–18.
- Al-Fraihat, D., Joy, M., & Sinclair, J. (2020). *Evaluating E-Learning Systems Success: An Empirical Study*. *Computers in Human Behavior*, 102, 67–86.

- Anene, J. N., Imam, H., & Odumuh, T. (2014). Problem and prospect e-learning in Nigerian universities. *International Journal of Technology and Inclusive Education (IJTIE)*, 3(2), 320-327.
- Bozkurt, A., Kondakci, Y., & Aydin, C. H. (2022). Digital transformation and openness in the Turkish Higher Education System. *VI Marín, LN Peters, & O. Zawacki-Richter (Eds.)*, 438-495.
- Braun, V., & Clarke, V. (2021). *Thematic Analysis: A Practical Guide*. London: Sage Publications.
- Bruner, J. (1996). *The Culture of Education*. Cambridge, MA: Harvard University Press.
- Downes, S. (2012). *Connectivism and Connective Knowledge: Essays on Meaning and Learning Networks*. National Research Council of Canada.
- Dhawan, S. (2020). *Online Learning: A Panacea in the Time of COVID-19 Crisis*. *Journal of Educational Technology Systems*, 49(1), 5-22.
- Emmanuel, F. C., Christian, A. O., & Henry, O. N. (2024). Comparative Analysis of Mainstreaming E-learning and Digital Divide: The Academia Perspectives. *International Journal of Research and Innovation in Applied Science*, 9(7), 73-85.
- Garrison, D. R., Anderson, T., & Archer, W. (2010). *The First Decade of the Community of Inquiry Framework: A Retrospective*. *Internet and Higher Education*, 13(1-2), 5-9.
- Inegbedion, H. E. (2021). Digital divide in the major regions of the world and the possibility of convergence. *The Bottom Line*, 34(1), 68-85.
- Kahu, E. R., & Nelson, K. (2018). *Student Engagement in the Educational Interface: Understanding the Mechanisms of Student Success*. *Higher Education Research & Development*, 37(1), 58-71.
- Kaqinari, T. (2023). Facilitators and barriers to online teaching and educational technology use by university lecturers during COVID-19: A systematic review of qualitative evidence. *Trends in Higher Education*, 2(4), 636-666.
- Lasekan, O. A., Pachava, V., Godoy Pena, M. T., Golla, S. K., & Raje, M. S. (2024). Investigating factors influencing students' engagement in sustainable online education. *Sustainability*, 16(2), 689.
- Means, B., Bakia, M., & Murphy, R. (2014). *Learning online: What research tells us about whether, when and how*. Routledge.. Routledge.
- Mtebe, J. S., Upor, R., & Raphael, C. (2025). Drivers and Barriers to Digital Transformation in Universities in Tanzania Post-COVID-19 Pandemic. *International Journal of Education & Development using Information & Communication Technology*, 21.
- National Information Technology Development Agency (NITDA). (2023). *National Digital Economy Policy and Strategy Progress Report*. Abuja: NITDA.
- Ndibalema, P. (2022). Constraints of transition to online distance learning in Higher Education Institutions during COVID-19 in developing countries: A systematic review. *E-learning and Digital Media*, 19(6), 595-618.
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory* (3rd ed.). New York: McGraw-Hill.
- Odekeye, O. T., Fakokunde, J. B., Metu, D. V., & Adewusi, M. A. (2023). Perception of Learning Management System (LMS) on the Academic Performance of Undergraduate Students during the COVID-19 Pandemic. *International Journal of Education and Development using Information and Communication Technology*, 19(1), 7-19.
- OECD. (2024). *Artificial Intelligence in Education: Emerging Trends and Ethical Considerations*. Paris: OECD Publishing.
- Olanrewaju, G. S., Adebayo, S. B., Omotosho, A. Y., & Olajide, C. F. (2021). Left behind? The effects of digital gaps on e-learning in rural secondary schools and remote communities across Nigeria during the COVID19 pandemic. *International journal of educational research open*, 2, 100092.
- Omodan, B. I., & Dube, B. (2023). *Pedagogical Reimagination in the Post-Pandemic Era: Lessons for African Universities*. *International Journal of Higher Education Innovation*, 9(3), 112-126.
- Saeid, E. (2025). Digital transformation of higher education in Sub-Saharan Africa: challenges and opportunities in advanced digital skills. *Journal of Social Transformation and Regional Development*, 7(2), 54-60.
- Siemens, G. (2005). *Connectivism: A Learning Theory for the Digital Age*. *International Journal of Instructional Technology and Distance Learning*, 2(1), 3-10.
- TETFund. (2023). Higher education in the digital age. *Convocation lecture delivered at the 26th convocation ceremony of Lagos state university, Ojo*
- Giannini, S. (2025). Reimagining the futures of education. *PROSPECTS*, 1-9.
- Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press.



Walimbwa, M. (2023). Digital transformation of higher education and twenty-first-century skilling in Sub-Saharan Africa: Potentials and challenges. *Higher Education in Sub-Saharan Africa in the 21st Century: Pedagogy, Research and Community-Engagement*, 313-325.