

Assessment of Institutional Preparedness for E-Learning Implementation in Tertiary Institutions in Kaduna State, Nigeria

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Abstract

The global transformation of higher education through digital technologies has positioned e-learning as indispensable, yet its effective implementation in developing countries remains challenging. This study comprehensively assesses e-learning platform preparedness in tertiary institutions across Kaduna State, Nigeria, examining technical infrastructure, faculty readiness, course quality, user experiences, and institutional management. Employing a cross-sectional survey design, data were collected from 396 respondents across eight public tertiary institutions using a validated questionnaire (Cronbach's $\alpha = 0.81-0.88$). Findings reveal significant disparities: specialised institutions demonstrate high preparedness (7.0/10), federal and state universities moderate preparedness (5.5–6.2), while polytechnics and colleges of education exhibit critically low preparedness (4.0–5.0). Inconsistent power supply (4.35/5.0), poor internet connectivity (4.28/5.0), and high data costs (4.12/5.0) emerged as the most severe challenges. Faculty training (2.65/5.0), course quality (2.90/5.0), and institutional management support (2.72/5.0) received consistently low ratings. The study reveals a triple digital divide—access, economic, and skill—systematically excluding disadvantaged students. Grounded in the Technology Acceptance Model and UTAUT, the findings confirm that facilitating conditions are primary determinants of e-learning adoption. The study concludes that the majority of institutions remain unprepared, with infrastructure deficits, capacity gaps, and weak governance constituting critical barriers. Recommendations include prioritised infrastructure investment, comprehensive faculty development, enhanced quality assurance, strengthened management frameworks, and alignment with emerging policy initiatives. This research contributes empirical evidence to inform strategic decision-making for harnessing e-learning's transformative potential in Nigerian tertiary education.

Keywords: *E-learning preparedness, digital divide, infrastructure challenges, tertiary education, Kaduna State, Nigeria*

Introduction

The global landscape of higher education is undergoing a profound transformation driven by the relentless integration of digital technologies into teaching, learning, and administrative processes. This digital revolution, accelerated significantly by the COVID-19 pandemic, has repositioned e-learning from a peripheral alternative to a central component of educational delivery worldwide

(UNESCO, 2020). In developing countries, particularly across sub-Saharan Africa, the imperative to adopt and effectively implement e-learning platforms is not merely a matter of pedagogical innovation but a critical strategy for expanding access to quality education, bridging geographical disparities, and building resilient educational systems capable of withstanding future disruptions (Delgado Martin & Larrú Ramos, 2025). Nigeria, as Africa's most populous nation, faces the urgent challenge of leveraging technology to educate its rapidly growing youth population, a task for which traditional brick-and-mortar infrastructure alone is demonstrably insufficient (Echono, 2025).

The Federal Government of Nigeria, through agencies such as the Tertiary Education Trust Fund (TETFund), has recognised this imperative and invested substantial resources in developing digital infrastructure and learning platforms like the Tertiary Education, Research, Applications and Services (TERAS) initiative. TETFund has issued clear directives for beneficiary institutions to integrate Information and Communication Technology (ICT) into teaching, research, and administration, warning that billions of naira already invested risk being wasted through underutilisation and institutional resistance to change (Echono, 2025; TETFund, 2025). Yet, despite these investments and policy directives, Nigerian tertiary institutions continue to lag in ICT adoption, with many schools maintaining what the TETFund Executive Secretary described as "embarrassingly outdated" online presences, positioning Nigeria 189th globally and 25th in Africa in education competitiveness (Tribune Online, 2025).

The successful deployment of e-learning platforms extends far beyond the procurement of hardware and software. It is a multidimensional endeavour contingent upon the interplay of critical factors spanning infrastructure, technology, pedagogy, human capacity, and institutional management (Khan, 2005). Infrastructure constitutes the foundational layer, encompassing reliable internet connectivity, adequate bandwidth, stable power supply, and accessible hardware for both faculty and students (Olaniyi, 2006). In the Nigerian context, inconsistent electricity supply, high costs of internet data, and poor network connectivity in many regions pose substantial barriers to seamless e-learning operations (Abubakar, 2025; Adeoye et al., 2020). This infrastructural deficit creates a digital divide that threatens to exacerbate, rather than ameliorate, existing educational inequalities.

Beyond infrastructure, the technological tools themselves—Learning Management Systems (LMS), virtual classrooms, multimedia resources, and collaborative platforms—must be robust, user-friendly, and reliably available. The quality of these platforms, assessed through criteria such as accessibility, usability, user engagement, support systems, and adaptability, fundamentally determines their educational effectiveness (Kuzmina et al., 2025). Furthermore, the preparedness of faculty members to effectively utilise these technological tools and adapt their pedagogical practices to online environments emerges as perhaps the most critical human factor. Faculty development through workshops, seminars, and continuous professional development is essential for equipping educators with requisite skills for effective online education delivery (Nwauwa, 2024). Research indicates that trained and supported faculty are significantly more likely to deliver online learning models effectively, yet faculty disinterest in professional development for online teaching remains a major challenge in Nigerian universities (Nwauwa, 2024).

Kaduna State, situated in Nigeria's North-West geopolitical zone, presents a particularly compelling context for investigating e-learning platform preparedness. The state hosts numerous tertiary institutions, including federal universities, state-owned universities, polytechnics, and colleges of education, all navigating the complex transition towards digital education. Despite its strategic importance and the presence of institutions like Ahmadu Bello University, Zaria one of Nigeria's premier universities—the state faces the full spectrum of challenges characteristic of developing country contexts. A comprehensive, multi-institutional assessment of e-learning platform preparedness across Kaduna State's diverse tertiary education landscape remains conspicuously absent from the literature. This study, therefore, addresses this critical gap by undertaking a comprehensive assessment of e-learning platform preparedness in tertiary institutions across Kaduna State.

Specifically, the study aims to: (1) evaluate the current state of technical infrastructure and technological resources available for e-learning; (2) assess the readiness of faculty members for online teaching and the nature and extent of training received; (3) examine the quality and content of online courses and learning materials; (4) identify the challenges encountered by students and instructors; and (5) formulate evidence-based strategies to enhance preparedness and effectiveness.

Literature Review

E-learning, broadly conceptualised, refers to the use of electronic technologies and media to deliver, support, and enhance teaching and learning processes (Garrison, 2011). Sangrà et al. (2012) proposed that e-learning be understood as an approach to teaching and learning, representing all or part of the educational model applied, that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction. The concept of e-learning readiness, or "e-readiness," refers to the degree to which an institution, its faculty, and its students are prepared to participate effectively in e-learning environments (Kaur & Abas, 2004). Chapnick (2000) proposed a comprehensive framework comprising eight categories: psychological readiness, sociological readiness, environmental readiness, human resource readiness, financial readiness, technological skill readiness, equipment readiness, and content readiness. Lopes (2007) subsequently synthesised these into four core dimensions: technological, human, institutional, and content readiness.

Davis (1989) posited that two primary beliefs—perceived usefulness and perceived ease of use—determine users' attitudes toward technology, which in turn influence their behavioural intentions and actual technology use. In the Nigerian context, Oye et al. (2014) employed TAM to examine the impact of e-learning on university students' performance, finding that both perceived usefulness and ease of use significantly influenced students' attitudes toward e-learning. Venkatesh et al. (2003) identified four core determinants: performance expectancy, effort expectancy, social influence, and facilitating conditions. UTAUT has proven particularly valuable for e-learning research in developing country contexts, where facilitating conditions—including infrastructure reliability, technical support, and institutional policies—often emerge as critical determinants of adoption success (Thomas et al., 2013). Khan (2005) identified eight critical dimensions: pedagogical, technological, interface design, evaluation, management, resource support, ethical, and institutional. This framework provides an appropriate theoretical lens for this study, as it

comprehensively addresses the multiple dimensions of e-learning preparedness central to the research objectives.

Infrastructure and Technological Resources

The foundational role of robust infrastructure in successful e-learning implementation is well established. Bates (2005) emphasised that effective e-learning requires not only reliable hardware and software but also sustainable systems for maintenance, upgrade, and technical support. In developed country contexts, infrastructure considerations typically focus on quality enhancement. However, in developing countries, the infrastructure discourse remains centred on fundamental availability and reliability (Unwin, 2008). Within Nigeria, Olaniyi (2006) identified inadequate telecommunications infrastructure, unreliable electricity supply, and high connectivity costs as primary barriers to e-learning adoption. Adeoye et al. (2020) confirmed that inconsistent power supply and limited internet access, particularly in remote areas, posed substantial barriers to seamless e-learning operations. More recently, Okonkwo and Ibe (2021) found that while most institutions had established LMS platforms, the reliability of these systems remained problematic. Research specifically focused on Kaduna State reveals infrastructure challenges that mirror national patterns. Kurawa et al. (2022) found inadequate electronic smart boards and identified inadequate funding and poor maintenance culture as factors deterring acquisition of state-of-the-art digital facilities. Tor et al. (2024) identified high data costs, time constraints, and high cost of electronic gadgets as major challenges confronting young people during e-learning engagement. Abubakar (2025) identified unstable electricity, prohibitive data costs, and poor connectivity as major obstacles at Ahmadu Bello University, Zaria.

Faculty Preparedness and Pedagogical Practices

Faculty readiness constitutes a critical determinant of e-learning success. Akuegwu (2024) demonstrated that teaching staff proficiency in e-learning-related activities and institutional provision for their e-learning needs remained significantly low, concluding that tertiary institutions were fundamentally unprepared for e-learning modes of instruction. Oscar et al. (2024) established significant correlation between inadequate funding and provision of ICT facilities, which hindered staff development efforts. Nwauwa (2024) found that trained and supported faculty are significantly more likely to understand and deliver online learning models effectively. The University of Lagos has implemented comprehensive training programmes for facilitators to ensure proficiency in online learning platforms and pedagogical approaches suited to learner-led interactions (University of Lagos, 2025). However, implementation of these programmes across institutions remains inconsistent.

Challenges Confronting E-Learning

Adeoye et al. (2020) identified unreliable internet connectivity, insufficient bandwidth, and inconsistent power supply as primary barriers. Okonkwo and Ibe (2021) documented the affordability dimension, noting that high data costs effectively exclude economically disadvantaged students from meaningful e-learning participation. Tor et al. (2024) found that many students in Northern Nigeria lacked the digital skills necessary for effective e-learning

engagement. Okonkwo (2021) examined digital literacy levels among university students, finding significant variation correlated with socioeconomic background, discipline, and prior technology access. Kurawa et al. (2022) identified inadequate funding and poor maintenance culture as factors deterring acquisition and sustainability of digital facilities. Research at Kaduna Polytechnic concluded that e-learning structure was at "low realm" (Sule Lamido University Journal, 2020). Kassam (2025) noted that policy frameworks have faced substantial implementation setbacks due to poor execution, lack of stakeholder knowledge, and inadequate funding mechanisms.

Methodology

Research Design

A cross-sectional survey research design was adopted, allowing for data collection from a large and diverse population at a single point in time, enabling assessment of the current state of e-learning preparedness across multiple institutions (Creswell & Creswell, 2018).

Study Area

Kaduna State, located in the North-West geopolitical zone of Nigeria, is a major educational hub hosting numerous tertiary institutions, including federal and state universities, polytechnics, and colleges of education. The choice of Kaduna State is justified by its significant concentration of institutions, making it a representative context for examining e-learning preparedness across different institutional types.

Population and Sample

The target population comprised students, faculty members, and ICT/administrative staff in eight public tertiary institutions in Kaduna State: Ahmadu Bello University, Zaria; Kaduna State University; Kaduna Polytechnic; Kaduna State College of Education, Gidan Waya; Nigerian Defence Academy; Federal University of Education, Zaria; Nuhu Bamalli Polytechnic, Zaria; and Air Force Institute of Technology, Kaduna. The total population was approximately 215,097 students and staff. Using the Taro Yamane formula with a 5% margin of error, a minimum sample of 400 respondents was required. A multistage sampling technique was employed: stratified sampling based on institution affiliation, followed by simple random sampling within each institution. A total of 396 responses were successfully collected and analysed, representing a 99% response rate.

Data Collection Instrument

The primary instrument was a structured questionnaire titled "Questionnaire for Assessment of E-Learning Platform Preparedness in Tertiary Institutions in Kaduna State." The questionnaire was divided into sections capturing: demographic information, technical infrastructure and resources, faculty preparedness and training, quality of online courses and materials, challenges faced, management and administrative support, recommendations, and overall assessment. Items employed a 5-point Likert scale, with additional 1-10 rating scales for overall preparedness. The

instrument was validated by five experts in educational technology and research methodology, with content validity index of 0.83. Reliability was established through pilot testing on 30 respondents, yielding Cronbach's alpha coefficients ranging from 0.81 to 0.88 across sections, exceeding the acceptable threshold of 0.70 (George & Mallery, 2019).

Data Collection and Analysis

Data collection was conducted over three months through a combination of physical and online administration. Quantitative data were analysed using SPSS version 27.0. Descriptive statistics (frequencies, percentages, means, standard deviations) were computed, and mean scores were interpreted using established ranges: 1.00–1.79 = Very Low, 1.80–2.59 = Low, 2.60–3.39 = Moderate, 3.40–4.19 = High, 4.20–5.00 = Very High.

Ethical Considerations

Ethical approval was obtained from institutional review boards. Informed consent was obtained from all participants, and confidentiality was assured. Participants were informed of their right to withdraw at any time.

Respondent Role and Epistemic Considerations

The study acknowledges that different respondent categories possess different epistemic perspectives on e-learning preparedness. Students (60% of the sample) provide perceptions of institutional readiness based on their experiences as learners; faculty members (35%) provide self-assessments of their own preparedness and institutional observations; and management/ICT staff (5%) provide direct knowledge of institutional policies, budgets, and infrastructure.

Following the recommendations of Podsakoff et al. (2003) on common method variance, the questionnaire was designed with items that are accessible to all respondent groups based on their observable experiences (e.g., "connectivity reliability," "power supply consistency") while distinguishing items requiring specific institutional knowledge. Items on disaster recovery plans, sustainable funding models, and technical support staffing are explicitly identified as items on which management/ICT staff provide the most valid responses, while students' perceptions of these items are treated as indicators of institutional visibility and communication effectiveness rather than objective measures.

To address differential validity concerns identified in methodological literature (Spector, 2006; Conway & Lance, 2010), all role-sensitive items are reported disaggregated by respondent role in Tables 6 and 11. This approach preserves the full sample size while enabling readers to evaluate response patterns across stakeholder groups. Where student and faculty perceptions converge, confidence in findings is strengthened; where they diverge, the divergence itself provides meaningful insight into institutional communication and stakeholder experience gaps.

Findings

The findings are organized according to the research objectives and presented using tables and descriptive statistics. Data were collected from 396 respondents across eight public tertiary institutions using a validated questionnaire with a reliability coefficient ranging from 0.81 to 0.88.

Response Rate by Institution

Table 1: Response Distribution by Institution

S/N	Institution	Target Sample	Responses Received	Response Rate
1	Ahmadu Bello University, Zaria	111	109	98.2%
2	Kaduna State University, Kaduna	94	93	98.9%
3	Kaduna Polytechnic, Kaduna	89	88	98.9%
4	Kaduna State College of Education, Gidan Waya	31	30	96.8%
5	Nigerian Defence Academy, Kaduna	28	28	100%
6	Federal University of Education, Zaria	12	12	100%
7	Nuhu Bamalli Polytechnic, Zaria	17	17	100%
8	Air Force Institute of Technology, Kaduna	8	8	100%
	TOTAL	400	396	99%

A total of 396 responses were successfully collected and analysed across the eight tertiary institutions, representing a 99% response rate of the target sample of 400. This high response rate enhances the generalizability of the findings.

Demographic Information of Respondents

Table 2: Respondent Demographics

Variable	Category	Frequency	Percentage
Status	Students	238	60%
	Faculty Members	138	35%
	Management/ICT Staff	20	5%
Gender	Male	230	58%
	Female	166	42%
Age Group	18–35 years	269	68%
	36–55 years	111	28%
	56 years and above	16	4%

The majority of respondents were students (60%), followed by faculty members (35%), and management/ICT staff (5%). Male respondents constituted 58% while females represented 42%.

The predominant age group was 18–35 years (68%), reflecting the youthful population of tertiary institutions.

Preparedness Scores by Institution

Table 3: Preparedness Scores by Institution

S/N	Institution	Preparedness Score	Category
1	Air Force Institute of Technology, Kaduna	7.0	High Preparedness
2	Nigerian Defence Academy, Kaduna	7.0	High Preparedness
3	Ahmadu Bello University, Zaria	6.2	Moderate Preparedness
4	Kaduna State University, Kaduna	5.9	Moderate Preparedness
5	Federal University of Education, Zaria	5.5	Moderate Preparedness
6	Kaduna Polytechnic, Kaduna	5.0	Low Preparedness
7	Nuhu Bamalli Polytechnic, Zaria	4.5	Low Preparedness
8	Kaduna State College of Education, Gidan Waya	4.0	Low Preparedness
	OVERALL MEAN	5.6	Moderate-Low

The findings reveal significant disparities in e-learning preparedness across institutions. Specialised institutions (AFIT and NDA) demonstrate high preparedness with scores of 7.0. Federal and state universities (ABU, KASU, FUEZ) exhibit moderate preparedness with scores ranging from 5.5 to 6.2. Polytechnics and colleges of education demonstrate critically low preparedness with scores ranging from 4.0 to 5.0. The overall mean preparedness score of 5.6 indicates moderate-low preparedness across the state.

Infrastructure and Technological Resources

Table 4: Infrastructure and Technological Resources Indicators

S/N	Indicator	Mean	Std. Dev.	Interpretation
1	Reliable internet connectivity	2.65	1.12	Low
2	Sufficient internet bandwidth	2.58	1.18	Low
3	Adequate computer hardware for students	2.72	1.08	Low
4	Adequate computer hardware for faculty	2.61	1.15	Low
5	Consistent power supply	2.18	1.24	Very Low
6	Functional Learning Management System (LMS)	3.15	1.02	Moderate
7	Mobile accessibility of platforms	3.28	0.98	Moderate
8	Technical support availability	2.89	1.05	Low
9	Physical infrastructure adequacy	2.76	1.10	Low

10	Equal access for remote students	2.15	1.21	Very Low
	OVERALL INFRASTRUCTURE SCORE	2.70	-	Low

The overall infrastructure score of 2.70 (Low) indicates that e-learning infrastructure across the institutions is inadequate. Consistent power supply (2.18) and equal access for remote students (2.15) received the lowest ratings (Very Low). Mobile accessibility (3.28) and functional LMS (3.15) received moderate ratings, suggesting that while platforms exist, their reliability and accessibility are compromised by foundational infrastructure deficits.

Infrastructure Indicators by Institution Type

Table 5: Infrastructure Scores by Institution Type

Institution Type	Internet Connectivity	Power Supply	LMS Functionality	Infrastructure
Specialized Institutions (AFIT, NDA)	3.85 (Moderate)	3.42 (Moderate)	4.15 (High)	3.72 (Moderate)
Federal Universities (ABU, FUEZ)	2.95 (Low)	2.25 (Very Low)	3.45 (Moderate)	2.85 (Low)
State University (KASU)	2.82 (Low)	2.10 (Very Low)	3.38 (Moderate)	2.75 (Low)
Polytechnics (KadPoly, Nuhu Bamalli)	2.25 (Very Low)	1.95 (Very Low)	2.65 (Low)	2.25 (Very Low)
College of Education (COE Gidan Waya)	2.10 (Very Low)	1.80 (Very Low)	2.45 (Low)	2.10 (Very Low)

Infrastructure scores vary significantly by institution type. Specialized institutions demonstrate moderate infrastructure (3.72), while polytechnics (2.25) and colleges of education (2.10) show very low infrastructure levels. Power supply is critically low across all non-specialized institutions, with polytechnics (1.95) and colleges of education (1.80) rating it as very low.

Faculty Preparedness and Training

Table 6: Faculty Preparedness and Training Indicators by Respondent Role

S/N	Indicator	Students (n=238) Mean	Faculty (n=138) Mean	Mgmt/ICT (n=20) Mean	Overall Mean	Interpretation
1	Faculty prepared for online teaching	2.75	3.15	2.85	2.88	Low
2	Regular training on e-learning methodologies	2.58	2.72	2.90	2.65	Low

3	Faculty possess necessary digital skills	2.95	3.25	3.10	3.02	Moderate
4	Adequate training on course design for online delivery	2.68	2.85	2.75	2.72	Low
5	Faculty confidence in using e-learning tools	3.08	3.35	3.05	3.15	Moderate
6	Ongoing professional development in e-learning	2.75	2.92	3.00	2.81	Low
7	Technical support for faculty using e-learning platforms	2.80	2.95	3.05	2.85	Low
8	Training programmes accessible to all faculty	2.62	2.78	2.85	2.68	Low
9	Faculty motivation to adopt e-learning	3.18	3.45	3.25	3.25	Moderate
10	Regular evaluation of e-learning competencies	2.35	2.55	2.65	2.42	Very Low
	OVERALL FACULTY PREPAREDNESS SCORE	2.77	2.98	2.95	2.82	Low

Note: Mean scores interpreted using established ranges: 1.00–1.79 = Very Low, 1.80–2.59 = Low, 2.60–3.39 = Moderate, 3.40–4.19 = High, 4.20–5.00 = Very High. Student responses represent perceptions of faculty preparedness; faculty responses represent self-assessments; management/ICT responses represent institutional observations. Disaggregation addresses differential epistemic validity concerns.

The overall faculty preparedness score of 2.82 (Low) indicates that faculty members are not adequately prepared for e-learning delivery. The disaggregated data reveal important differences in how stakeholders perceive faculty preparedness. Faculty members rated their own preparedness more positively (2.98) than students rated faculty preparedness (2.77), though both fall within the "low" preparedness category. This gap is most pronounced for "Faculty prepared for online teaching," where students rated faculty at 2.75 (Low) while faculty rated themselves at 3.15 (Moderate). Regular evaluation of e-learning competencies received the lowest rating (2.42 – Very Low), suggesting that institutions do not systematically assess faculty readiness. Faculty motivation (3.25) and confidence in using e-learning tools (3.15) received moderate ratings, indicating willingness that is not matched by institutional support and training.

Faculty Training Frequency

Table 7: Faculty Training Frequency

Training Frequency	Percentage
Never	35%
Once a year	28%
Twice a year	20%
Quarterly	10%
Monthly	7%

Only 37% of faculty members receive training at least twice a year, while 35% have never received any e-learning training. This indicates a significant gap in faculty development for e-learning.

Quality of Online Courses and Materials

Table 8: Quality of Online Courses and Materials Indicators

S/N	Indicator	Mean	Std. Dev.	Interpretation
1	Online courses are well-structured	2.95	1.05	Low
2	Content meets academic standards	3.12	0.98	Moderate
3	Learning materials are engaging and interactive	2.85	1.12	Low
4	Courses are regularly updated	2.78	1.15	Low
5	Alignment of objectives and learning activities	3.05	1.00	Moderate
6	Assessment methods are appropriate	3.18	0.95	Moderate
7	Timely feedback on assignments	2.82	1.10	Low
8	Multimedia resources adequately used	2.75	1.18	Low
9	Courses accommodate different learning styles	2.90	1.08	Low
10	Comparable to traditional instruction quality	2.88	1.05	Low
	OVERALL COURSE QUALITY SCORE	2.90	-	Low

The overall course quality score of 2.90 (Low) indicates that the quality of online courses and materials is inadequate. Multimedia resources usage (2.75) and regular course updates (2.78) received the lowest ratings. Assessment methods (3.18) and content meeting academic standards (3.12) received moderate ratings, suggesting that while assessment exists, the overall pedagogical quality of online courses is underdeveloped.

Challenges Faced by Students and Instructors

Table 9: Severity of Challenges

S/N	Challenge	Mean	Std. Dev.	Severity Category
1	Inconsistent power supply	4.35	0.85	Very Severe

2	Poor internet connectivity	4.28	0.88	Very Severe
3	High cost of data	4.12	0.92	Severe
4	Lack of access to devices (laptops, smartphones)	3.98	0.95	Severe
5	Technical glitches and platform downtime	3.85	0.98	Severe
6	Insufficient technical support	3.72	1.02	Severe
7	Difficulty adapting teaching methods for online delivery	3.68	1.05	Severe
8	Limited student-instructor interaction	3.55	1.08	Moderate-Severe
9	Lack of digital literacy among students	3.52	1.10	Moderate-Severe
10	Difficulty maintaining student engagement	3.48	1.05	Moderate
11	Academic dishonesty in online assessments	3.35	1.12	Moderate
12	Lack of motivation for online learning	3.28	1.08	Moderate
13	Inadequate institutional e-learning policies	3.15	1.15	Moderate
	OVERALL CHALLENGE SEVERITY SCORE	3.68	-	Severe

The overall challenge severity score of 3.68 (Severe) indicates that institutions face significant barriers to effective e-learning implementation. Inconsistent power supply (4.35) and poor internet connectivity (4.28) are the most severe challenges, rated as "Very Severe." High cost of data (4.12), lack of access to devices (3.98), and technical glitches (3.85) are rated as "Severe" challenges. The economic barriers (data costs and device access) are particularly concerning as they directly affect student access and equity.

Challenges by Institution Type

Table 10: Top Three Challenges by Institution Type

Institution Type	Challenge 1	Challenge 2	Challenge 3
Specialized Institutions	High data cost (4.02)	Power supply (3.85)	Connectivity (3.78)
Federal Universities	Power supply (4.32)	Connectivity (4.28)	High data cost (4.15)
State University (KASU)	Power supply (4.38)	Connectivity (4.32)	High data cost (4.18)
Polytechnics	Power supply (4.45)	Connectivity (4.40)	Device access (4.15)
College of Education	Power supply (4.50)	Connectivity (4.48)	Device access (4.22)

Inconsistent power supply and poor internet connectivity are the top two challenges across all institution types. However, specialized institutions rate high data cost as their primary challenge, while polytechnics and colleges of education rate device access as their third most severe challenge, reflecting the economic disadvantage of students in these institutions.

Institutional Management and Administrative Support

Table 11: Institutional Management Support Indicators by Respondent Role

S/N	Indicator	Students (n=238) Mean	Faculty (n=138) Mean	Mgmt/ICT (n=20) Mean	Overall Mean	Interpretation
1	Adequate financial resources for e-learning infrastructure	2.58	2.72	3.05	2.65	Low
2	Clear institutional policies on e-learning implementation	2.72	2.85	3.10	2.78	Low
3	Dedicated technical support staff for e-learning	2.65	2.78	3.15	2.72	Low
4	Regular evaluation of e-learning effectiveness	2.48	2.62	2.85	2.55	Low
5	Disaster recovery plans for e-learning systems	2.10	2.25	2.65	2.18	Very Low
6	Management commitment to e-learning initiatives	2.88	3.05	3.20	2.95	Low
7	Strategic planning for e-learning integration	2.55	2.68	3.05	2.62	Low
8	Coordination between ICT and academic departments	2.82	2.95	3.10	2.88	Low
9	Sustainable funding model for e-learning	2.35	2.48	2.80	2.42	Very Low
10	Institutional culture supportive of e-learning	2.75	2.88	3.00	2.80	Low
	OVERALL MANAGEMENT SUPPORT SCORE	2.54	2.70	2.95	2.58	Low

Note: Student responses on items 1, 2, 4, 5, 7, 9, and 10 represent perceptions rather than direct knowledge of institutional management practices. Management and ICT staff responses (n=20) are considered the most valid source for items 3, 5, 8, and 9, which require specific institutional knowledge. The overall low scores across all respondent groups suggest consistency in perceptions of inadequate management support, though the epistemic basis differs by respondent role.

The overall management support score of 2.58 (Low) indicates that institutional management and administrative support for e-learning is critically inadequate. Disaster recovery plans (2.18) and sustainable funding models (2.42) received the lowest ratings (Very Low). The disaggregated data reveal a consistent pattern: management and ICT staff (the most knowledgeable respondents for institutional-level items) rated management support most positively (2.95), followed by faculty (2.70), while students rated it lowest (2.54). This hierarchy of perceptions—from most positive to most negative—is consistent with the "proximity effect," where those closest to institutional decision-making have more optimistic assessments than those most distant from it.

Management commitment (2.95) and coordination between ICT and academic departments (2.88) received low ratings, suggesting that while there is some awareness of e-learning needs, systematic support is lacking.

Management Support by Institution Type

Table 12: Management Support Scores by Institution Type

Institution Type	Financial Resources	Policy Framework	Technical Support	Overall Management
Specialized Institutions	3.15 (Moderate)	3.25 (Moderate)	3.35 (Moderate)	3.18 (Moderate)
Federal Universities	2.75 (Low)	2.85 (Low)	2.80 (Low)	2.78 (Low)
State University (KASU)	2.68 (Low)	2.72 (Low)	2.65 (Low)	2.68 (Low)
Polytechnics	2.35 (Low)	2.45 (Low)	2.38 (Low)	2.38 (Low)
College of Education	2.20 (Very Low)	2.30 (Low)	2.25 (Low)	2.25 (Low)

Management support varies by institution type, with specialized institutions showing moderate management support (3.18), while colleges of education show very low support (2.25). Polytechnics also demonstrate low management support (2.38). Financial resources are consistently rated low across all non-specialized institutions.

Digital Divide and Equity Concerns

Table 13: Digital Divide Indicators

S/N	Indicator	Mean	Std. Dev.	Interpretation
1	Equal access to e-learning for remote area students	2.15	1.21	Very Low
2	Availability of devices for economically disadvantaged students	2.02	1.25	Very Low
3	Affordability of data for all students	1.88	1.28	Very Low
4	Digital literacy levels among students	2.48	1.15	Low

5	Accommodation for students with disabilities	2.25	1.20	Very Low
6	Access to offline learning resources	2.35	1.18	Low
7	Gender equity in e-learning access	3.05	0.98	Moderate
	OVERALL EQUITY SCORE	2.31	-	Very Low

The overall equity score of 2.31 (Very Low) reveals a severe digital divide. Data affordability (1.88) received the lowest rating, followed by device availability for disadvantaged students (2.02) and equal access for remote area students (2.15). Accommodation for students with disabilities is also very low (2.25). Gender equity (3.05) is the only indicator receiving a moderate rating.

Triple Digital Divide

Table 14: The Triple Digital Divide

Divide Type	Indicator	Mean	Severity
Access Divide	Equal access for remote students	2.15	Very Low
	Access for students with disabilities	2.25	Very Low
Economic Divide	Data affordability	1.88	Very Low
	Device availability	2.02	Very Low
Skills Divide	Student digital literacy	2.48	Low

The study identifies a triple digital divide affecting students: (1) Access Divide – students in remote areas and those with disabilities are systematically excluded; (2) Economic Divide – high data costs and lack of devices exclude economically disadvantaged students; (3) Skills Divide – limited digital literacy compounds access and economic barriers. These three divides interact to create compounded disadvantages for the most vulnerable students.

Preparedness Category by Institution

Table 15: Summary of Preparedness Categories

Institution	Score	Category	Key Characteristics
AFIT, Kaduna	7.0	High Preparedness	Good connectivity, moderate power, high digital skills, available LMS, specialized funding
NDA, Kaduna	7.0	High Preparedness	Good connectivity, moderate power, high digital skills, available LMS, security focus
ABU, Zaria	6.2	Moderate Preparedness	Moderate connectivity, poor power, high digital skills, available LMS
KASU, Kaduna	5.9	Moderate Preparedness	Moderate connectivity, poor power, moderate-high skills, available LMS
FUEZ, Zaria	5.5	Moderate Preparedness	Moderate connectivity, poor power, moderate-high skills, available LMS

Kaduna Polytechnic	5.0	Low Preparedness	Poor connectivity, poor power, moderate skills, limited LMS
Nuhu Bamalli Polytechnic	4.5	Low Preparedness	Poor connectivity, poor power, low-moderate skills, limited LMS
COE Gidan Waya	4.0	Low Preparedness	Poor connectivity, very poor power, low-moderate skills, limited LMS

The eight institutions fall into three distinct preparedness categories. High Preparedness Institutions (AFIT, NDA) benefit from specialized funding and security-related priorities. Moderate Preparedness Institutions (ABU, KASU, FUEZ) have established LMS platforms but struggle with infrastructure reliability and training. Low Preparedness Institutions (KadPoly, Nuhu Bamalli, COE) face compounded challenges of poor connectivity, unreliable power, limited LMS functionality, and inadequate faculty training.

Discussion

Preparedness Disparities Across Institutions

The findings reveal a clear and concerning pattern of disparity in e-learning preparedness across institutions. Institutions can be categorised into three distinct groups: High Preparedness Institutions (NDA, AFIT, scores 7.0), benefiting from specialised funding, security-related priorities, and better infrastructure; Moderate Preparedness Institutions (ABU, KASU, FUEZ, scores 5.5–6.2), with established LMS platforms but struggling with infrastructure reliability and training; and Low Preparedness Institutions (KadPoly, Nuhu Bamalli, COE Gidan Waya, scores 4.0–5.0), facing compounded challenges of poor connectivity, unreliable power, limited LMS functionality, and inadequate faculty training.

This pattern correlates with national findings by Akuegwu (2024), who noted that funding levels correlate strongly with e-learning preparedness. The findings confirm that institutional type and funding sources significantly influence e-learning readiness, consistent with Okonkwo and Ibe (2021) who found that while Nigerian federal universities have made progress in LMS adoption, reliability remains problematic. The preparedness scores align closely with socioeconomic and resource availability, reflecting the broader national challenges identified by Adeoye et al. (2020) and Tor et al. (2024).

Infrastructure as the Most Critical Barrier

Inconsistent power supply (4.35/5.0) and poor internet connectivity (4.28/5.0) emerged as the most severe challenges, with over 80% of respondents rating these as severe or very severe. This finding strongly validates earlier research of Abubakar (2025) at Ahmadu Bello University and the national survey where 69.7% cited lack of internet connectivity and 69.0% cited poor power supply as the most common barriers (Okafor et al., 2024). The power supply challenge is particularly acute in institutions like Kaduna State College of Education (very poor) and Kaduna Polytechnic (poor), where the absence of reliable power compromises even available ICT infrastructure. This

reinforces Kurawa et al.'s (2022) observation that poor maintenance culture and inadequate power supply deter acquisition and sustainability of digital facilities.

The high cost of data (4.12/5.0) emerged as a critical economic barrier, affecting students disproportionately. This aligns with Tor et al. (2024), who identified high data costs as the most significant economic barrier to e-learning engagement among Northern Nigerian youth. The economic dimension of the digital divide cannot be overstated: students from economically disadvantaged backgrounds are systematically excluded from e-learning when data costs are prohibitive. As Adieze (2024) found, socioeconomic factors are critical determinants of e-learning adoption in developing countries. These findings confirm the relevance of UTAUT's facilitating conditions construct (Venkatesh et al., 2003), which posits that organisational and technical infrastructure are critical determinants of technology acceptance. Where infrastructure is inadequate, even motivated users cannot effectively engage with e-learning platforms.

Faculty Preparedness: Perceptual and Self-Assessment Gaps

Faculty preparedness reveals a significant capacity gap. Despite policies promoting e-learning integration, faculty members report low levels of adequate training (2.65/5.0), low confidence in online teaching (3.15/5.0), and very low frequency of regular e-learning evaluation (2.42/5.0). This finding resonates with Akuegwu's (2024) conclusion that teaching staff proficiency in e-learning-related activities and institutional provision for their needs remain "significantly low," rendering tertiary institutions fundamentally unprepared for e-learning modes of instruction.

The disaggregated data in Table 6 reveal important differences in how stakeholders perceive faculty preparedness. Faculty members rated their own preparedness more positively (2.98) than students rated faculty preparedness (2.77), though both fall within the "low" preparedness category. This gap is most pronounced for "Faculty prepared for online teaching," where students rated faculty at 2.75 (Low) while faculty rated themselves at 3.15 (Moderate). This perceptual gap may reflect: (1) faculty overconfidence in their digital teaching competencies, consistent with the Dunning-Kruger effect documented in educational technology research (Kruger & Dunning, 1999); (2) students' heightened expectations for online teaching quality; or (3) genuine deficiencies in faculty teaching practices that are not captured by self-assessment.

Notably, both students and faculty rated training accessibility and regular evaluation of e-learning competencies as low or very low, suggesting convergence on the inadequacy of institutional training programmes. The convergence of perceptions across stakeholder groups strengthens confidence in the finding that faculty development is critically insufficient.

A significant disconnect exists between willingness and actual utilisation. While national studies show that 79.7% of trainers are very willing to integrate e-learning (Okafor et al., 2024), current study findings reveal low actual adoption. Fakinlede et al. (2025) found that Nigerian lecturers possess relatively good internet access and basic technology skills, suggesting that institutional support—not individual resistance—may be the primary constraint. The study's low training scores reflect inadequate institutional support rather than faculty unwillingness. The variation in faculty preparedness mirrors institutional disparities. At high-preparedness institutions, faculty report

higher digital skills and more frequent training, while at low-preparedness institutions, faculty report feeling ill-equipped and unsupported. This finding has significant implications: faculty development must be recognised as a prerequisite for successful e-learning implementation, consistent with Nwauwa's (2024) finding that trained and supported faculty are significantly more likely to deliver online learning models effectively.

Course Quality: Underdeveloped Pedagogy

Course quality received consistently low ratings across institutions (overall mean 2.90/5.0). While some institutions have established LMS platforms, the pedagogical quality is inadequate. Key weaknesses include lack of engagement and interactivity (2.85/5.0), limited multimedia usage (2.75/5.0), irregular content updates (2.78/5.0), and weak feedback mechanisms (2.82/5.0).

This finding highlights a fundamental challenge: the presence of technology does not guarantee pedagogical quality. As Anderson (2008) and Salmon (2013) have emphasised, effective online teaching requires deliberate course design that leverages digital affordances while mitigating limitations. In Kaduna State institutions, this pedagogical shift has not yet occurred. The finding also reinforces Durán and Gutiérrez's (2023) observation that quality assurance in e-learning requires systematic attention to pedagogical design, not just technological provision. The most striking comparison is with medical education findings, where 51.7% of trainers were against clinical demonstrations and 54.7% against bedside teaching via e-learning (Okafor et al., 2024), suggesting that professional disciplines requiring hands-on learning face unique pedagogical challenges. The study treats all disciplines uniformly, potentially masking discipline-specific preparedness gaps.

The Triple Digital Divide

The study identifies a triple digital divide: (1) Access Divide: Students in remote areas reported very low equal access (2.15/5.0), reflecting significant geographical disparities; (2) Economic Divide: High data costs (4.12/5.0) and lack of devices (3.98/5.0) disproportionately affect economically disadvantaged students; (3) Skills Divide: Students' limited digital literacy (3.52/5.0) compounds access challenges.

This pattern of inequality is particularly concerning because e-learning, if not carefully designed, can exacerbate rather than ameliorate existing educational inequalities (Warschauer, 2003). When students from remote, economically disadvantaged communities cannot reliably access e-learning platforms, the technology intended to democratise education instead functions as a new mechanism of exclusion. The findings from Kaduna State align with broader national challenges identified by Adeoye et al. (2020) and Tor et al. (2024), who documented the compounded challenges facing students in remote areas of Nigeria.

Institutional Management and Policy Gaps: Differential Perspectives

Institutional management received consistently low ratings across all institutions. Key gaps include inadequate financial resources (2.65/5.0), weak policy frameworks (2.78/5.0), insufficient

technical support staff (2.72/5.0), limited evaluation of e-learning effectiveness (2.55/5.0), and absence of disaster recovery plans (2.18/5.0).

The disaggregated data in Table 11 reveal a consistent pattern: management and ICT staff (the most knowledgeable respondents for institutional-level items) rated management support most positively (2.95), followed by faculty (2.70), while students rated it lowest (2.54). This hierarchy of perceptions—from most positive to most negative—is consistent with the "proximity effect," where those closest to institutional decision-making have more optimistic assessments than those most distant from it.

The items requiring specific institutional knowledge—disaster recovery plans (2.18) and sustainable funding models (2.42)—received consistently very low ratings across all respondent groups, suggesting that even students perceive the absence of these critical institutional supports. The convergence across groups on these items, despite differential epistemic bases, strengthens confidence in the conclusion that institutional management support is critically inadequate.

This finding confirms the importance of the management dimension identified by Khan (2005) and Bates (2005). The absence of coherent management frameworks, systematic evaluation mechanisms, and sustainable funding models perpetuates cycles of fragmented, unsustainable e-learning initiatives. The finding also supports Kassam's (2025) observations on significant implementation challenges confronting Nigeria's policy frameworks for educational technology. Despite national policies, many public institutions were unprepared during the COVID-19 pandemic, leaving large numbers of students without access to continuous academic engagement.

Theoretical Implications

The findings are consistent with TAM and UTAUT. Adieze (2024) found that perceived usefulness, perceived ease of use, and social influences significantly influence educators' adoption of e-learning technologies. The current study's finding of moderate faculty confidence but low training suggests that facilitating conditions (infrastructure, support, training) are the primary constraints, consistent with UTAUT's emphasis on organisational and technical infrastructure. The disconnect between faculty willingness (79.7% very willing in national studies) and actual utilisation is best explained by facilitating conditions rather than individual attitudes.

Policy Context

A significant positive development is missing from the discussion: Kaduna State is actively pursuing digital education reforms. The state is set to sign a Memorandum of Understanding with the University of London to strengthen online and distance education, with a central Learning Management System to be deployed at Kaduna State University as a model for scale-up (Sambo, 2026). Selected academics will receive training in digital pedagogy and course delivery, and joint research and academic exchange programmes are planned. This recent policy initiative provides critical context and suggests that significant improvements may be imminent.

Conclusion

This study conducted a comprehensive assessment of e-learning platform preparedness in tertiary institutions across Kaduna State, Nigeria. Based on findings from 396 respondents across eight institutions, several critical conclusions emerge regarding the current state of e-learning preparedness in the state.

First, significant disparities exist across institutions, with specialised institutions such as the Nigerian Defence Academy and Air Force Institute of Technology demonstrating high preparedness with scores of 7.0 out of 10, while conventional universities exhibit moderate preparedness ranging from 5.5 to 6.2, and polytechnics and colleges of education demonstrate critically low preparedness between 4.0 and 5.0. This finding indicates that the overall state of e-learning preparedness in the majority of institutions is inadequate for delivering quality digital education, with institutional type and funding sources emerging as primary determinants of readiness.

Second, inconsistent power supply, rated at 4.35 out of 5.0, and poor internet connectivity, rated at 4.28 out of 5.0, represent the most severe challenges confronting e-learning implementation across all institutions. The economic dimension of the digital divide, manifested through high data costs at 4.12 out of 5.0, effectively excludes economically disadvantaged students from meaningful e-learning participation, creating a system where access to digital education is determined by socioeconomic status rather than academic merit or institutional provision.

Third, faculty members report low levels of training at 2.65 out of 5.0, limited confidence in online teaching at 3.15 out of 5.0, and very low frequency of regular e-learning evaluation at 2.42 out of 5.0. The disaggregated data reveal a perceptual gap: faculty self-assessments are consistently higher than student perceptions of faculty preparedness (2.98 vs. 2.77), suggesting possible overconfidence or differing expectations. This finding reveals that without systematic, ongoing faculty development programmes, institutions cannot effectively transition to e-learning modes of instruction, regardless of the technological infrastructure available. The gap between faculty willingness to adopt e-learning and the institutional support provided represents a critical bottleneck in the digital transformation of tertiary education.

Fourth, the quality of online courses and materials remains low, with an overall score of 2.90 out of 5.0. Courses lack interactivity, engagement, multimedia resources, and regular updating, suggesting that institutions have focused on platform availability rather than pedagogical quality. The presence of technology does not guarantee pedagogical quality, and institutions have not yet made the fundamental pedagogical shift required for effective online education delivery.

Fifth, management support is critically inadequate at 2.58 out of 5.0, with the absence of coherent strategies, sustainable funding models, systematic evaluation mechanisms, and disaster recovery plans perpetuating fragmented, unsustainable e-learning initiatives. The disaggregated data reveal a hierarchy of perceptions: management/ICT staff rated support most positively (2.95), followed by faculty (2.70), while students rated it lowest (2.54). This proximity effect suggests that those closest to institutional decision-making perceive greater support than those most distant from it.

Without strong institutional governance and strategic planning, even well-intentioned e-learning investments risk becoming isolated projects that fail to achieve systemic transformation.

Finally, e-learning platforms in their current state risk exacerbating existing educational inequalities rather than ameliorating them. The triple digital divide—comprising access disparities between urban and rural areas, economic barriers related to data costs and device availability, and skills gaps in digital literacy—represents a fundamental equity challenge that must be addressed if e-learning is to fulfil its promise of democratising access to quality education. If left unaddressed, these divides will create a two-tiered educational system where students from privileged backgrounds with reliable connectivity and devices thrive while their less-privileged counterparts are systematically disadvantaged.

Recommendations

For Institutional Administrators

Based on the findings of this study, institutional administrators are urged to take decisive action across five critical areas to enhance e-learning preparedness and effectiveness in their institutions.

First, administrators must prioritise infrastructure investment as the foundational element of e-learning success. This involves investing in alternative power sources such as solar panels and generators to address the critical challenge of inconsistent electricity supply, which was identified as the most severe barrier across all institutions with a severity rating of 4.35 out of 5.0. Additionally, institutions should upgrade internet connectivity and bandwidth, with particular attention to remote areas where students face the greatest access challenges. Establishing dedicated e-learning support centres with adequate technical staffing is essential to provide ongoing assistance to both faculty and students.

Second, developing comprehensive faculty training programmes is imperative for building the human capacity necessary for effective e-learning delivery. Institutions should implement mandatory, ongoing training programmes on e-learning methodologies that address both technical competencies and pedagogical strategies for online teaching. To encourage faculty engagement, institutions should create incentive structures such as recognition awards and promotion points that reward participation in professional development activities. Establishing mentorship programmes that pair experienced online educators with those developing e-learning competencies can facilitate peer learning and knowledge transfer. The perceptual gap identified in this study—where faculty self-assessments exceed student perceptions—suggests that training programmes should include robust evaluation mechanisms to ensure actual competency development rather than mere confidence building.

Third, enhancing course quality and pedagogical design is essential for ensuring that e-learning platforms deliver meaningful educational experiences. Institutions should develop institutional quality assurance frameworks for online courses that address structure, content, engagement, and assessment. Providing instructional design support to faculty for creating engaging, interactive online learning materials can help bridge the gap between traditional teaching approaches and the

requirements of effective online education. Furthermore, institutions must ensure regular course updates to reflect current knowledge and pedagogical research.

Fourth, strengthening management frameworks is critical for creating the institutional conditions that enable sustainable e-learning initiatives. Administrators should develop clear institutional policies on e-learning implementation that define roles, responsibilities, and expectations for all stakeholders. Allocating sustainable budgets for e-learning maintenance, upgrade, and support is essential to prevent the deterioration of infrastructure and the fragmentation of initiatives. Establishing regular evaluation mechanisms to assess e-learning effectiveness enables evidence-based decision-making and continuous improvement. Creating disaster recovery plans for e-learning systems ensures institutional resilience in the face of technical failures or other disruptions.

Fifth, addressing the digital divide is a moral and practical imperative for institutional administrators committed to equitable education. This involves providing subsidised devices to economically disadvantaged students who cannot afford the laptops or smartphones necessary for e-learning participation. Establishing computer labs with reliable power and internet access for students without personal devices creates alternative access points that can significantly expand e-learning reach. Developing offline-capable e-learning resources for areas with poor connectivity ensures that students in remote locations are not systematically excluded from digital learning opportunities.

For Government and Policymakers

Government and policymakers at both state and national levels have a critical role to play in creating the enabling environment for effective e-learning implementation across tertiary institutions. Based on the findings of this study, five key areas require policy attention and strategic intervention.

First, developing comprehensive e-learning policy frameworks is essential for providing clear direction and accountability. Governments should establish state-level e-learning policies with explicit implementation guidelines, sustainable funding mechanisms, and robust accountability measures that ensure policy intentions translate into tangible outcomes. These policies should mandate minimum e-learning infrastructure standards for all tertiary institutions, creating a baseline that ensures no institution is left behind in the digital transformation of education. Such standards should address connectivity requirements, hardware provisions, and institutional support structures, providing a clear roadmap for institutional compliance and development.

Second, investing in statewide digital infrastructure is fundamental to overcoming the infrastructural barriers that currently constrain e-learning effectiveness. Governments should collaborate with telecommunication companies to expand broadband infrastructure to underserved areas, recognising that internet access is now as essential as electricity and water for educational participation. Developing shared Learning Management Systems that can be deployed across multiple institutions would significantly reduce individual institutional costs while promoting standardisation and interoperability. Investing in renewable energy solutions such as solar power

for educational institutions would address the persistent challenge of inconsistent electricity supply, creating more reliable conditions for e-learning engagement.

Third, establishing quality assurance frameworks is crucial for ensuring that e-learning delivers educational value rather than merely expanding access to poor-quality instruction. Governments should develop standardised quality assurance frameworks for online courses and programmes that address pedagogical design, content quality, student engagement, and assessment integrity. Integrating e-learning competencies into accreditation and institutional evaluation criteria would incentivise institutions to prioritise quality in their digital offerings. Establishing monitoring and evaluation mechanisms to track e-learning effectiveness across institutions would generate the evidence base needed for continuous improvement and informed policy development.

Fourth, addressing economic barriers is essential for ensuring that e-learning does not become a mechanism of exclusion. Governments should provide subsidised data plans for students and faculty, recognising that high data costs represent one of the most significant barriers to e-learning participation. Establishing device loan programmes for economically disadvantaged students would address the device access gap that currently excludes many from digital learning opportunities. Including e-learning costs in student funding through scholarships, grants, or loans would ensure that financial constraints do not determine educational opportunity in the digital age.

Fifth, fostering inter-institutional collaboration would enable institutions to pool resources, share expertise, and learn from each other's experiences. Creating statewide e-learning networks for resource sharing and professional development would facilitate the dissemination of best practices and reduce duplication of effort. Facilitating public-private partnerships for e-learning infrastructure would leverage private sector expertise and resources while maintaining public sector oversight and equity commitments. Such collaborative approaches would accelerate the digital transformation of tertiary education while ensuring that the benefits of e-learning are distributed equitably across institutions and student populations.

For Future Research

While this study has provided valuable insights into the current state of e-learning preparedness in Kaduna State, several important areas require further investigation to deepen understanding and inform evidence-based policy and practice. Future research should prioritise longitudinal studies that track changes in e-learning preparedness over time, examining how infrastructure investments, faculty development programmes, and policy interventions influence institutional readiness and educational outcomes. Such studies would provide critical evidence on what works, for whom, and under what conditions, enabling more targeted and effective interventions.

The experiences of marginalised student populations warrant particular attention in future research. Studies should investigate the specific challenges and coping strategies of students with disabilities, those from remote areas, and those from economically disadvantaged backgrounds, whose voices are often absent from mainstream e-learning discourse. Understanding how these students navigate e-learning environments, what barriers they encounter, and what support

mechanisms enable their success would inform the design of more inclusive and equitable e-learning systems.

Research should also examine the effectiveness of specific pedagogical approaches on student engagement and learning outcomes in online environments. Comparative studies across different disciplines, course types, and student populations would generate evidence on which pedagogical strategies are most effective for which learning objectives. Additionally, investigating the implementation processes of e-learning initiatives, including the factors that facilitate or hinder successful adoption, would provide practical guidance for institutional change management and strategic planning.

Finally, future research should examine the effectiveness of different faculty development approaches for building e-learning competencies, comparing the impact of workshops, mentorship programmes, online courses, and communities of practice on faculty attitudes, skills, and teaching practices. Analysing the implementation of national and state policies on e-learning and identifying strategies for strengthening policy effectiveness would help bridge the persistent gap between policy aspiration and implementation reality, ensuring that the substantial investments in educational technology translate into meaningful improvements in teaching and learning outcomes.

Limitations of the Study

While this study provides insights into e-learning preparedness across Kaduna State's tertiary institutions, several methodological limitations warrant acknowledgment.

First, the study employed a cross-sectional design, capturing data at a single point in time. This limits the ability to assess changes in preparedness over time or establish causal relationships between institutional factors and e-learning outcomes. Longitudinal studies would be valuable for understanding how infrastructure investments and policy interventions influence preparedness trajectories.

Second, the study relied on self-reported data through a structured questionnaire. Self-report measures are subject to social desirability bias, recall limitations, and individual response tendencies. While the questionnaire was validated and reliability coefficients were acceptable (Cronbach's $\alpha = 0.81\text{--}0.88$), these limitations inherent in survey research must be considered when interpreting findings.

Third, and most significantly, the study acknowledges differential epistemic validity across respondent categories. Students (60% of the sample) rated items on faculty preparedness and institutional management—constructs for which they have limited direct knowledge. Faculty members provided self-assessments, which may be subject to social desirability and self-enhancement biases. Management and ICT staff (5% of the sample) provided assessments of institutional policies and resources, but the small sample size in this category limits the statistical power for subgroup analyses.

To address this limitation, all role-sensitive items are reported disaggregated by respondent role in Tables 6 and 11, allowing readers to assess response patterns across stakeholder groups. Where findings are consistent across respondent categories, confidence in conclusions is strengthened; where patterns diverge, interpretations have been appropriately qualified. The disaggregated data reveal valuable insights: faculty self-assessments exceed student perceptions (2.98 vs. 2.77), and management/ICT staff perceptions exceed both faculty and student perceptions (2.95 vs. 2.70 vs. 2.54). These patterns themselves provide meaningful information about institutional communication gaps and stakeholder experience differences. Future research should consider oversampling management and ICT staff to enable more robust subgroup analyses of institutional-level variables.

Fourth, the study focused on eight public tertiary institutions in Kaduna State, limiting generalisability to private institutions, other states in Nigeria, or other national contexts. The findings are representative of the institutional types included but may not reflect the experiences of institutions with different funding models, governance structures, or geographic locations.

Fifth, the study did not include objective measures of infrastructure (e.g., actual bandwidth speeds, power outage frequency, LMS server uptime) or direct observation of faculty teaching practices. Such objective measures would complement the perceptual data collected and provide a more comprehensive assessment of institutional preparedness.

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