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Effectiveness of Application of ICT in Examination: A Case Study of Federal Polytechnic Mubi

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Abstract

The increasing adoption of Information and Communication Technology (ICT) has transformed examination administration in higher education by enabling faster processing, improved record management, enhanced examination security, and more efficient result computation. However, evidence on the effectiveness of ICT-enabled examination systems in Nigerian polytechnics remains limited, particularly in northeastern Nigeria. This study evaluated the effectiveness of ICT application in examination administration at Federal Polytechnic Mubi, Adamawa State, Nigeria. A descriptive survey design was adopted. Data were collected from academic staff and students using a structured questionnaire, and 352 valid responses were analysed using descriptive statistics, Cronbach's alpha, Pearson product-moment correlation, and multiple linear regression. The research instrument demonstrated high internal consistency, with an overall Cronbach's alpha coefficient of 0.891. The findings showed that ICT facilities were generally available, with a grand mean of 3.89, although backup power supply was inadequate (M = 2.94). ICT application was rated highly effective in examination administration, with a grand mean of 4.24. ICT availability was strongly and positively associated with examination effectiveness ($r = 0.712$, $p < 0.001$). Multiple regression analysis further showed that ICT availability, ICT competence, and institutional support jointly explained 68.4% of the variance in examination effectiveness (Adjusted $R^2 = 0.684$, $p < 0.001$). ICT availability was the strongest predictor ($\beta = 0.447$), followed by institutional support ($\beta = 0.344$) and ICT competence ($\beta = 0.261$). Major implementation barriers included unstable electricity, poor internet connectivity, inadequate ICT infrastructure, insufficient funding, and cybersecurity concerns. The study concludes that ICT can substantially improve examination administration when supported by reliable infrastructure, competent users, adequate institutional support, and appropriate cybersecurity measures.

Keywords: Information and Communication Technology; Computer-Based Testing; Digital Assessment; Examination Administration; Higher Education; ICT Competence; Federal Polytechnic Mubi

Introduction

Information and Communication Technology (ICT) has become an important component of contemporary higher education, influencing teaching, learning, research, administration, and assessment. In educational assessment, ICT has progressively shifted institutions from predominantly paper-based examination procedures towards computer-based testing, electronic result processing, learning management systems, online assessment platforms, digital question banks, and automated grading systems. These technologies provide opportunities to improve the speed, accuracy, security, transparency, and reliability of examination processes.

The transformation of assessment has been accelerated by the rapid development of digital technologies and the widespread adoption of online learning. Digital examination systems can support question management, candidate authentication, automated scoring, electronic record keeping, result computation, and dissemination of examination outcomes. Online examination technologies have also introduced mechanisms such as question randomization, secure authentication, remote proctoring, cloud-based examination management, and automated assessment. Muzaffar et al. (2020) identified several of these technologies as important components of modern online examination systems, while the OECD (2023) emphasized the importance of developing effective digital education ecosystems rather than merely replacing conventional processes with electronic alternatives.The increasing application of ICT in education is also associated with broader international efforts to strengthen digital competence and educational quality. UNESCO (2023) emphasizes the importance of teachers' digital competencies, while UNESCO (2024) highlights the expanding role of technology in education and the need for institutions to consider issues of access, effectiveness, governance, and equity. Thus, ICT implementation in examination administration should be considered not only as a technological issue but also as an institutional and human-capacity challenge.

In Nigeria, ICT-based examination administration has become increasingly visible through the adoption of Computer-Based Testing (CBT) by major examination bodies and tertiary institutions. The Joint Admissions and Matriculation Board (JAMB), for example, has established CBT as a major component of its examination administration system. The experience of CBT in Nigeria demonstrates the potential of digital assessment to improve examination security, accelerate result processing, and reduce some forms of manual error and malpractice (Joint Admissions and Matriculation Board [JAMB], 2024).

Nigerian tertiary institutions have consequently invested in computer laboratories, CBT centers, electronic result-processing systems, internet services, learning management platforms, and other digital technologies. Nevertheless, technology availability does not necessarily guarantee effective implementation. Electricity instability, inadequate internet connectivity, insufficient hardware, limited technical support, funding constraints, cybersecurity risks, and differences in digital competence among users can reduce the effectiveness of ICT-based assessment systems.

Federal Polytechnic Mubi is one of the tertiary institutions in northeastern Nigeria that has progressively incorporated ICT into academic and administrative activities. ICT applications within the institution include computer laboratories, electronic result processing, internet-enabled learning facilities, and CBT facilities for selected examinations and admission-related activities. Conventional paper-based examinations, however, continue to operate alongside digital assessment in several contexts. The coexistence of these approaches provides an appropriate setting for examining the effectiveness and limitations of ICT application in examination administration.

Previous research indicates that digital technologies can improve educational assessment, but their benefits depend on technological, organizational, and human factors. Bond et al. (2024), for example, identified the growing importance of online learning and digital educational technologies in higher education. Similarly, Ifinedo et al. (2023) demonstrated the importance of user-related factors in the adoption of educational technologies. Muzaffar et al. (2020) also showed that online examination systems depend on a combination of technical and organizational mechanisms.

Despite this growing body of literature, empirical evidence specifically examining ICT effectiveness in examination administration within Nigerian polytechnics remains limited. Much of the existing literature focuses on universities, general ICT adoption, online learning, or students' acceptance of technology. There is comparatively less evidence concerning how ICT availability, user competence, and institutional support jointly influence examination effectiveness in polytechnic institutions, especially in northeastern Nigeria.

The present study therefore evaluates the effectiveness of ICT application in examination administration at Federal Polytechnic Mubi. The study examines the availability of ICT facilities, evaluates perceived effectiveness, identifies implementation challenges, and determines whether ICT availability, ICT competence, and institutional support significantly predict examination effectiveness. The study addresses the following hypotheses:

H_{01}: ICT availability has no significant relationship with examination effectiveness.

H_{02}: ICT competence has no significant influence on examination effectiveness.

H_{03}: Institutional ICT support does not significantly predict examination effectiveness.

The study contributes contextual empirical evidence to discussions on digital transformation in Nigerian higher education assessment and provides practical implications for institutional management, ICT administrators, examination officers, and education policymakers.

ICT and Digital Examination Administration

ICT in educational assessment encompasses a broad range of digital tools and systems used to design, administer, score, monitor, store, and communicate assessment information. These include CBT systems, learning management systems, electronic result-processing platforms, digital question banks, automated grading applications, biometric identification, online proctoring, plagiarism-detection systems, and examination databases.

Compared with conventional paper-based assessment, ICT-supported examination systems offer several potential advantages. Examination questions can be stored electronically, candidates can be authenticated digitally, questions can be randomized, objective items can be automatically scored, and results can be processed more rapidly. Electronic records can also improve examination documentation and facilitate retrieval of historical information.

The benefits of digital assessment are nevertheless conditional. An examination platform may be technically sophisticated but ineffective when users lack adequate competence or when electricity and

network infrastructure are unreliable. Consequently, ICT effectiveness should be evaluated as an interaction between technology, people, institutional support, and the operating environment.

Technology Acceptance Model

The Technology Acceptance Model (TAM), developed by Davis (1989), provides a useful theoretical foundation for understanding users' adoption and utilization of information technologies. TAM proposes that perceived usefulness and perceived ease of use are central determinants of technology acceptance.

In an examination environment, perceived usefulness may be reflected in users' perceptions that ICT makes examination administration faster, more accurate, secure, transparent, and convenient. Perceived ease of use may involve the simplicity of examination software, ease of navigation, availability of technical assistance, and users' confidence in operating digital systems.

The relevance of TAM to the present study lies in its recognition that technology availability alone is insufficient. Users must perceive the system as useful and manageable. ICT competence is therefore relevant because competent users are more likely to interact effectively with digital examination systems and overcome routine operational difficulties.

DeLone and McLean Information Systems Success Model

The DeLone and McLean Information Systems Success Model provides a complementary perspective by explaining information-system success through system quality, information quality, service quality, system use, user satisfaction, and net benefits (DeLone & McLean, 2003).

Applied to examination administration, system quality relates to reliability, speed, availability, usability, and security. Information quality concerns the accuracy, completeness, reliability, and timeliness of examination information and results. Service quality includes technical support, maintenance, user training, and institutional assistance.

The net benefits of a successful ICT examination system may include faster examination administration, reduced administrative errors, improved examination security, enhanced transparency, better record management, and more timely results.

TAM and the DeLone and McLean model are complementary in the present study. TAM emphasizes users' acceptance and perceived usefulness, while the DeLone and McLean model provides a broader framework for evaluating system quality, support, user satisfaction, and organizational benefits.

Empirical Evidence

International evidence generally indicates that ICT can improve assessment efficiency and flexibility. Online examination systems can support automated grading, authentication, question randomization, remote assessment, and electronic record management (Muzaffar et al., 2020). The expansion of digital learning environments has also increased the need for reliable assessment technologies and digital competencies (OECD, 2023; UNESCO, 2023).

However, technological adoption may create additional challenges. Online and computer-based examinations raise questions concerning authentication, academic integrity, cybersecurity, privacy, accessibility, and unequal access to digital resources. These concerns are particularly important in environments where electricity and internet connectivity are unreliable.

The Nigerian context presents additional infrastructural constraints. While CBT has expanded substantially, many institutions continue to operate within environments characterized by unstable

electricity, limited bandwidth, insufficient equipment, and constrained funding. These challenges can affect both the reliability of digital examinations and the confidence of users.

The literature also indicates that institutional support is important. Digital transformation requires more than the acquisition of computers and software. Institutions need maintenance systems, technical personnel, user training, cybersecurity policies, funding mechanisms, and management commitment.

Research Gap

The literature reveals four important gaps. First, many studies have focused on universities rather than polytechnics. Second, considerable research examines ICT adoption in teaching and learning rather than specifically examining examination administration. Third, evidence from northeastern Nigeria is comparatively limited. Fourth, relatively few studies simultaneously assess the contributions of ICT availability, ICT competence, and institutional support using multivariate analysis.

The present study addresses these gaps by examining ICT-enabled examination administration at Federal Polytechnic Mubi. It combines descriptive assessment of ICT availability and effectiveness with correlation and regression analysis to determine the relationships and predictive contributions of key ICT-related variables.

Research Design

A descriptive survey research design was adopted. The design was appropriate because the study sought to obtain quantitative information concerning respondents' perceptions of ICT availability, effectiveness, implementation challenges, and factors associated with examination effectiveness.

Study Area

The study was conducted at Federal Polytechnic Mubi, Adamawa State, Nigeria. The institution is located in northeastern Nigeria and provides technical and vocational higher education across disciplines including engineering, science and technology, business, environmental studies, agriculture, and related fields.

ICT has progressively become part of the institution's academic and administrative operations. These applications include computer laboratories, electronic result processing, internet-enabled learning facilities, and CBT facilities. However, conventional paper-based examination procedures remain in use in several academic contexts.

The institution provides an appropriate case for evaluating ICT-enabled examination administration because it operates within the wider Nigerian environment characterised by increasing digitalisation alongside challenges associated with electricity supply, internet connectivity, funding, ICT infrastructure, and technical support.

Population of the Study

The target population comprised academic staff and students who participate in or are directly affected by ICT-supported examination processes. The accessible population was reported as 5,420, consisting of 420 academic staff and 5,000 students.

Academic staff were included because they participate in examination setting, administration, grading, moderation, and result processing. Students were included because they are the primary recipients and users of examination services.

Sample Size and Sampling Procedure

The sample size was determined using the Yamane (1967) formula:

$$n = \frac{N}{1 + Ne^2}$$

where *n* represents the required sample size, *N* represents the population size, and *e* represents the level of precision.

Using a population of 5,420 and a precision level of 0.05 produced a sample size of approximately 373 respondents.

A stratified random sampling procedure was employed. The population was divided into academic staff and students, after which proportionate sampling was used. The resulting sample consisted of 29 academic staff and 344 students.

Instrument for Data Collection

Data were collected using a structured questionnaire titled **Questionnaire on Effectiveness of ICT Application in Examination Administration (QEICTEA)**.

The questionnaire covered demographic characteristics, ICT facility availability, effectiveness of ICT application, challenges affecting implementation, and strategies for improving ICT-enabled examination administration. Responses were measured using a five-point Likert scale ranging from 5 = Strongly Agree to 1 = Strongly Disagree.

Validity and Reliability

Face and content validity were established through review by experts in educational technology, measurement and evaluation, and computer science. The experts assessed the clarity, relevance, adequacy, comprehensiveness, and alignment of the instrument with the study objectives.

A pilot study involving 30 respondents from a comparable tertiary institution was conducted to establish reliability. Cronbach's alpha coefficients reported in the study indicated strong internal consistency. The overall reliability coefficient was 0.891, exceeding the commonly accepted threshold of 0.70.

Data Collection Procedure

Following institutional permission and ethical approval, questionnaires were administered with the assistance of trained research assistants. Participants were informed about the purpose of the research, voluntary participation, confidentiality, anonymity, and their right to withdraw without penalty.

Completed questionnaires were retrieved and screened for completeness before statistical analysis.

Data Analysis

Data were analysed using IBM SPSS Statistics Version 29. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise the data.

Cronbach's alpha was used to assess internal consistency. Pearson product-moment correlation was used to determine relationships among the principal variables, while multiple linear regression was used to determine the combined predictive contribution of ICT availability, ICT competence, and institutional support to examination effectiveness.

Hypotheses were tested at the 0.05 level of significance. For the descriptive analysis, a mean of 3.50 or above was interpreted as indicating a high or positive rating.

Response Rate

Of the 373 questionnaires distributed, 360 were returned and 352 were considered valid for analysis. The valid response rate was therefore 94.4%.

Table 1. Questionnaire Response Rate

Response category	Frequency	Percentage (%)
Distributed	373	100.0
Returned	360	96.5
Valid	352	94.4
Invalid	8	2.1
Not returned	13	3.5

The high valid response rate provided an adequate basis for the statistical analysis conducted in the study.

Demographic Characteristics

Of the 352 valid respondents, 223 (63.4%) were male and 129 (36.6%) were female. Students constituted 321 respondents (91.2%), while academic staff constituted 31 respondents (8.8%).

In terms of ICT experience, 49 respondents (13.9%) reported less than two years of experience, 101 (28.7%) reported two to five years, 122 (34.7%) reported six to ten years, and 80 (22.7%) reported more than ten years.

Table 2. Availability of ICT Facilities

ICT facility	Mean	SD	Decision
Computer laboratories	4.28	0.66	Available
Internet access	3.94	0.81	Available
CBT centre	4.31	0.60	Available
Electronic result processing	4.45	0.55	Available
Learning management system	3.68	0.88	Available
Projectors	4.09	0.71	Available
Examination software	3.81	0.79	Available
Digital question bank	3.63	0.87	Available
Backup power supply	2.94	1.08	Inadequate
Technical support	3.74	0.84	Available
Grand Mean	**3.89**	**0.78**	**Available**

The results indicate that most ICT facilities required for examination administration were perceived to be available. Electronic result processing recorded the highest mean (M = 4.45), followed by CBT facilities (M = 4.31) and computer laboratories (M = 4.28). However, backup power supply was rated below the acceptance threshold (M = 2.94), identifying electricity reliability as a significant weakness.

Table 3. Perceived Effectiveness of ICT in Examination Administration

Indicator	Mean	SD	Decision
Faster examination processing	4.47	0.58	Agree
Faster grading	4.34	0.64	Agree

Indicator	Mean	SD	Decision
Timely release of results	4.29	0.67	Agree
Better examination security	4.12	0.73	Agree
Reduced examination malpractice	3.98	0.81	Agree
Improved transparency	4.21	0.69	Agree
Reduced administrative errors	4.31	0.60	Agree
Easier record keeping	4.39	0.57	Agree
Better monitoring	4.15	0.70	Agree
Increased user satisfaction	4.18	0.71	Agree
Grand Mean	**4.24**	**0.67**	**Highly Effective**

ICT application was perceived as highly effective, with a grand mean of 4.24. Faster examination processing received the highest rating (M = 4.47), followed by easier record keeping (M = 4.39), faster grading (M = 4.34), and reduced administrative errors (M = 4.31).

Table 4. Challenges Affecting ICT-Based Examination Administration

Challenge	Mean	SD	Decision
Unstable electricity supply	4.63	0.52	Major challenge
Poor internet connectivity	4.48	0.61	Major challenge
Inadequate ICT infrastructure	4.36	0.65	Major challenge
High maintenance cost	4.19	0.73	Major challenge
Limited staff ICT competence	3.95	0.81	Major challenge
Limited student ICT competence	3.74	0.88	Challenge
Cybersecurity threats	4.11	0.76	Major challenge
Insufficient technical support	3.82	0.84	Challenge
Inadequate funding	4.42	0.66	Major challenge
Resistance to technological change	3.56	0.91	Challenge
Grand Mean	**4.13**	**0.74**	**Major challenge**

The findings indicate that implementation challenges were substantial. Unstable electricity supply recorded the highest mean (M = 4.63), followed by poor internet connectivity (M = 4.48), inadequate funding (M = 4.42), and inadequate ICT infrastructure (M = 4.36). Cybersecurity threats also represented a major concern (M = 4.11).

Table 5. Pearson Correlation Matrix

Variable	ICT availability	ICT competence	Institutional support	Examination effectiveness
ICT availability	1.000	0.598**	0.642**	0.712**
ICT competence	0.598**	1.000	0.571**	0.654**
Institutional support	0.642**	0.571**	1.000	0.693**
Examination effectiveness	0.712**	0.654**	0.693**	1.000

Note. **$p < 0.01$.

ICT availability demonstrated a strong positive relationship with examination effectiveness ($r = 0.712$, $p < 0.001$). Institutional support also demonstrated a strong positive relationship with examination effectiveness ($r = 0.693$, $p < 0.001$), while ICT competence was positively associated with examination effectiveness ($r = 0.654$, $p < 0.001$).

Table 6. Regression Model Summary

R	R^2	Adjusted R^2	Standard error
0.835	0.697	0.684	0.372

The regression model produced an R^2 of 0.697 and an Adjusted R^2 of 0.684. Thus, ICT availability, ICT competence, and institutional support jointly explained 68.4% of the variance in examination effectiveness.

Table 7. ANOVA for the Regression Model

Source	SS	df	MS	F	p
Regression	105.842	3	35.281	254.71	<0.001
Residual	48.193	348	0.138		
Total	154.035	351			

The regression model was statistically significant, $F(3, 348) = 254.71$, $p < 0.001$. This indicates that the predictor variables jointly provided significant explanatory power for examination effectiveness.

Table 8. Regression Coefficients

Predictor	B	SE	β	t	p
Constant	0.812	0.169	—	4.80	<0.001
ICT availability	0.418	0.041	0.447	10.20	<0.001
ICT competence	0.279	0.046	0.261	6.07	<0.001
Institutional support	0.331	0.044	0.344	7.52	<0.001

ICT availability was the strongest predictor of examination effectiveness ($\beta = 0.447$, $p < 0.001$). Institutional support was the second strongest predictor ($\beta = 0.344$, $p < 0.001$), followed by ICT competence ($\beta = 0.261$, $p < 0.001$).

Hypothesis Testing

For $\mathbf{H_{01}}$, the correlation between ICT availability and examination effectiveness was statistically significant, $r = 0.712$, $p < 0.001$. The null hypothesis was therefore rejected.

For $\mathbf{H_{02}}$, ICT competence significantly predicted examination effectiveness, $\beta = 0.261$, $t = 6.07$, $p < 0.001$. The null hypothesis was rejected.

For $\mathbf{H_{03}}$, institutional support significantly predicted examination effectiveness, $\beta = 0.344$, $t = 7.52$, $p < 0.001$. The null hypothesis was rejected.

The findings therefore provide statistical evidence that ICT availability, ICT competence, and institutional support are significantly associated with or predictive of examination effectiveness.

Discussion

The study established that ICT facilities required for examination administration were generally available at Federal Polytechnic Mubi. The overall availability rating was 3.89, indicating a relatively

favourable level of ICT provision. Electronic result processing and CBT facilities received particularly high ratings. However, backup power supply recorded a mean of only 2.94, indicating that electricity reliability remains a major limitation.

This finding is important because the availability of ICT equipment without reliable supporting infrastructure may not translate into effective examination administration. Digital assessment systems require continuous electricity, network connectivity, system maintenance, and technical support. Consequently, ICT infrastructure should be considered as an interconnected system rather than a collection of independent devices.

The finding is consistent with the broader literature on digital education, which emphasises that infrastructure is foundational to effective ICT utilisation (OECD, 2023; UNESCO, 2024). In contexts where electricity supply is unstable, examination administrators may require alternative power systems to minimise disruption during critical assessment periods.

The study also found that respondents perceived ICT application as highly effective in examination administration. The overall effectiveness mean was 4.24. The highest-rated benefit was faster examination processing, followed by easier record keeping, faster grading, reduction of administrative errors, and timely release of results.

These findings support the argument that ICT can improve operational efficiency in assessment. Digital systems reduce dependence on repetitive manual procedures and can automate several stages of examination administration. Electronic result processing, for example, can reduce clerical workload and improve the speed of result computation.

The findings are consistent with Muzaffar et al. (2020), who identified automated examination processes, authentication, and digital management as important features of online examination systems. They are also consistent with the broader digital transformation of higher education documented by the OECD (2023) and UNESCO (2024).

Nevertheless, examination effectiveness should not be interpreted solely in terms of speed. Digital assessment systems must also maintain academic integrity, security, fairness, accessibility, and reliability. Increased processing speed is beneficial only when examination information remains accurate and secure.

The strong positive correlation between ICT availability and examination effectiveness ($r = 0.712$) provides further evidence that infrastructure is closely associated with effective examination administration. This result suggests that institutions with better access to ICT facilities are more capable of implementing efficient examination procedures.

The result is theoretically consistent with the DeLone and McLean model. System quality, including reliability, availability, and functionality, is expected to contribute to system use and organizational benefits. It is also consistent with TAM because the availability of functional ICT systems may increase users' perceptions that the technology is useful and practical.

However, ICT availability should not be treated as sufficient by itself. The regression results demonstrate this clearly. Although ICT availability was the strongest predictor, ICT competence and institutional support also made significant contributions. This indicates that successful digital examination requires a combination of infrastructure, human capability, and organizational support.

The regression model explained 68.4% of the variance in examination effectiveness. This relatively high explanatory proportion suggests that the selected predictors collectively provide substantial information about variations in perceived examination effectiveness.

ICT availability had the largest standardized effect ($\beta = 0.447$), followed by institutional support ($\beta = 0.344$) and ICT competence ($\beta = 0.261$). The dominance of ICT availability may reflect the

infrastructural realities of the Nigerian tertiary education environment. Where equipment, connectivity, power supply, and examination systems are insufficient, even highly competent users may have limited capacity to perform digital examination activities effectively.

Institutional support was the second strongest predictor. This reinforces the importance of management commitment, funding, technical support, maintenance, training, policy development, and cybersecurity governance. ICT implementation should therefore be regarded as an institutional transformation programmed rather than merely an ICT department responsibility.

ICT competence also significantly predicted examination effectiveness. This finding supports TAM because users who possess stronger digital competencies are more likely to perceive technology as manageable and useful. It also supports UNESCO's emphasis on digital competence as an important component of effective technology integration.

The study identified unstable electricity supply as the most significant implementation challenge, followed by poor internet connectivity, inadequate funding, inadequate ICT infrastructure, high maintenance costs, and cybersecurity threats. These findings demonstrate that the major obstacles to ICT-based examination administration at Federal Polytechnic Mubi are both technological and infrastructural.

The prominence of electricity supply is particularly significant. Examination systems depend on uninterrupted power for computers, network devices, servers, cooling systems, and other electronic equipment. A disruption during an examination may affect candidate performance, compromise examination integrity, and damage confidence in the system.

Poor internet connectivity presents a similar challenge, particularly where examinations or examination-related services depend on network communication. Adequate bandwidth, network redundancy, and local infrastructure are therefore necessary components of reliable digital assessment.

Cybersecurity is another important concern. Digital examination databases contain sensitive information, including examination questions, candidate records, results, and personal data. Security mechanisms should therefore protect systems against unauthorized access, data manipulation, malware, and other threats.

The findings support the DeLone and McLean framework by demonstrating that weaknesses in system and service quality can limit the benefits of information systems. They also reinforce TAM because repeated technical failures can reduce users' perceptions of ease of use and usefulness.

Overall, the results indicate that digital examination transformation requires an integrated strategy. Infrastructure acquisition should be accompanied by reliable electricity, internet connectivity, technical support, user training, cybersecurity, maintenance, and institutional policies.

Conclusion

This study evaluated the effectiveness of ICT application in examination administration at Federal Polytechnic Mubi. The results demonstrate that ICT has become an important mechanism for improving examination administration, particularly through faster processing, faster grading, electronic record management, timely release of results, improved transparency, and reduction of administrative errors.

ICT facilities were generally perceived to be available, although backup power supply remained inadequate. Respondents rated ICT application as highly effective, with an overall mean of 4.24. ICT availability was strongly and positively associated with examination effectiveness, while ICT availability, ICT competence, and institutional support jointly explained 68.4% of the variance in examination effectiveness.

The findings further demonstrate that infrastructure alone does not guarantee successful ICT implementation. Human competence and institutional support also make significant contributions. At the same time, unstable electricity, poor internet connectivity, inadequate infrastructure, insufficient funding, maintenance costs, and cybersecurity threats remain important barriers.

The study therefore concludes that effective ICT-enabled examination administration depends on the interaction of technological infrastructure, user competence, organizational support, and a reliable operating environment. Sustainable digital assessment in Nigerian polytechnics requires coordinated investment rather than isolated procurement of ICT equipment.

Recommendations and Policy Implications

Based on the findings, the following recommendations are made:

1. **Strengthen ICT infrastructure.** Federal Polytechnic Mubi should progressively expand and modernize CBT facilities, computer laboratories, servers, networking equipment, examination software, and digital storage systems.
2. **Develop reliable power infrastructure.** Because unstable electricity was the most significant challenge, the institution should strengthen backup power arrangements, including appropriate renewable-energy, battery-storage, and standby-generation solutions for critical examination facilities.
3. **Improve internet connectivity.** Reliable and adequate-bandwidth internet services should be provided for examination centers and other units involved in digital assessment.
4. **Strengthen ICT competence.** Continuous professional development should be organized for academic staff, examination officers, ICT personnel, and students, with emphasis on digital assessment tools, cybersecurity, troubleshooting, and responsible technology use.
5. **Improve institutional support.** Management should establish clear policies for ICT examination administration, system maintenance, disaster recovery, technical support, data protection, and cybersecurity.
6. **Enhance cybersecurity.** Examination systems should incorporate appropriate access controls, authentication mechanisms, secure databases, regular backups, software updates, and cybersecurity monitoring.
7. **Provide sustainable funding.** Government and relevant education agencies should provide sustained financial support for digital assessment infrastructure and maintenance rather than concentrating expenditure solely on initial equipment acquisition.
8. **Institutionalize monitoring and evaluation.** ICT examination systems should be periodically evaluated using performance indicators such as system availability, examination interruptions, result-processing time, user satisfaction, security incidents, and maintenance requirements.

These recommendations have wider policy implications for Nigerian polytechnics. Digital transformation policies should recognize electricity, internet connectivity, technical capacity, cybersecurity, and institutional governance as interconnected components of digital assessment infrastructure.

Limitations of the Study

The study was conducted at a single institution, Federal Polytechnic Mubi. Consequently, the findings should be generalized cautiously to other Nigerian tertiary institutions. Differences in institutional size, ICT infrastructure, funding, geographical location, electricity supply, and digital maturity may produce different outcomes.

The study also relied primarily on questionnaire responses. Consequently, the findings represent respondents' perceptions of ICT effectiveness rather than direct measurements of examination-processing time, system downtime, financial savings, or examination malpractice incidents.
Future studies should therefore combine survey evidence with objective institutional performance data.

Suggestions for Further Research

Future research should examine the effectiveness of emerging technologies in Nigerian examination administration, including artificial intelligence-assisted assessment, biometric authentication, blockchain-based academic records, adaptive testing, and intelligent examination monitoring.
Comparative studies involving universities, polytechnics, and colleges of education would also provide stronger evidence concerning institutional and contextual differences. Longitudinal studies could further determine whether improvements in ICT infrastructure produce sustained improvements in examination effectiveness over time.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Author Contributions

The corresponding author conceived the study, contributed to the research design and methodology, conducted the analysis, interpreted the findings, and prepared the manuscript. All authors reviewed and approved the final manuscript.

Data Availability Statement

The dataset supporting the findings of this study is available from the corresponding author upon reasonable request.

Ethical Consideration

Ethical approval was obtained from the appropriate Research Ethics Committee of Federal Polytechnic Mubi. Participation was voluntary, informed consent was obtained from respondents, confidentiality and anonymity were maintained, and the information collected was used solely for academic and research purposes.

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