



Bridging the Digital Divide in Nigerian Federal Universities: Digital Infrastructure, Assessment Literacy and AI Readiness as Predictors of Students' Digital Assessment Competence, Assessment Self-Efficacy and Academic Engagement

By

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Abstract

The rapid digital transformation of higher education has created unprecedented opportunities for expanding access, improving assessment practices and developing future-ready graduates, but persistent inequalities in infrastructure, digital competence and readiness for artificial intelligence continue to constrain these possibilities in many African universities. This study examined the predictive contributions of digital infrastructure accessibility, digital assessment literacy and artificial intelligence-enabled assessment readiness to students' digital assessment competence, assessment self-efficacy and academic engagement in Nigerian Federal Universities. A descriptive survey research design was adopted. The population comprised 363,143 Federal University students, from which a sample of 384 students was selected. Data were collected using a structured instrument titled Digital Divide and Future-Ready Assessment Questionnaire (DDFRAQ). The instrument was subjected to expert validation and pilot testing, with acceptable reliability coefficients. Data were analysed using means, standard deviations and multiple regression analysis at the 0.05 significance level. The results indicated that digital infrastructure accessibility significantly predicted digital assessment competence ($R^2 = 0.480$), assessment self-efficacy ($R^2 = 0.420$) and academic engagement ($R^2 = 0.390$). Digital assessment literacy and AI-enabled assessment readiness also made significant positive contributions to the three dependent variables. The findings suggest that closing the digital divide requires more than providing internet connectivity and devices; it requires simultaneous investment in assessment literacy, ethical AI readiness, inclusive digital infrastructure and student support systems. The study concludes that Nigerian Federal Universities can develop future-ready assessment ecosystems when technological access is integrated with measurement competence and responsible AI use.

Keywords: digital divide, digital assessment, assessment literacy, artificial intelligence, assessment self-efficacy, academic engagement, higher education, Nigerian Federal Universities

Introduction

Higher education is undergoing a profound transformation as digital technologies increasingly influence how universities teach, assess, communicate, generate knowledge and prepare students for employment. The traditional university ecosystem, characterised largely by face-to-face instruction, paper-based assessment and relatively stable disciplinary boundaries, is progressively being complemented by learning management systems, computer-based testing, electronic portfolios, online examinations, learning analytics, automated feedback and artificial intelligence (AI). Consequently, the future-ready university is no longer defined only by the physical quality of its classrooms, libraries and laboratories, it

is also defined by its capacity to provide equitable digital access and to ensure that students and lecturers possess the competencies required to use digital technologies meaningfully and responsibly (Getenet et al. 2024).

This transformation is particularly significant in Africa. UNESCO (2024) observes that African higher education is at a critical turning point, with a rapidly expanding youth population, increasing demand for tertiary education and persistent inequalities in access and quality. Africa has one of the world's youngest populations, and the number of young Africans completing secondary or tertiary education is expected to increase substantially over the coming decades. This demographic reality creates both an opportunity and a

challenge for universities. Institutions must expand access while simultaneously ensuring that graduates possess the digital, analytical, technological and professional competencies demanded by contemporary societies.

Digital technology has the potential to help African universities respond to these challenges. Digital platforms can expand access to learning materials, support flexible learning, facilitate collaboration across geographical boundaries, provide rapid feedback and create new possibilities for assessment. UNESCO's ICT Transforming Education in Africa initiative specifically emphasises digital pedagogical transformation, improved digital competencies and the development of public digital learning platforms and content (Getenet et al. 2024).

Nevertheless, technology does not automatically produce educational equity. The digital divide involves disparities in access to devices, broadband connectivity, electricity, digital platforms, technical support, affordability and the skills required to use digital technologies effectively. In Sub-Saharan Africa, the problem is therefore multidimensional. Students may have mobile phones but lack reliable broadband, they may have internet access but insufficient data, they may have devices but lack the digital literacy required to undertake sophisticated academic activities, or they may possess basic digital skills but lack the competencies necessary to participate effectively in technology-mediated assessment (Bandura, 1997).

Recent evidence illustrates the seriousness of the problem. A World Bank assessment of higher education connectivity in Sub-Saharan Africa reported that, on average, 41% of students did not have internet access in lecture rooms and 33% did not have internet access in ICT laboratories or their universities. The situation was particularly challenging in Central and West Africa. The report consequently emphasised the need to strengthen National Research and Education Networks and campus-level connectivity.

The Nigerian context is particularly important. Nigeria has recognised the strategic significance of digital learning and has developed policy initiatives intended to support technology-enabled education. The Federal Ministry of Education's National Digital Learning Policy emphasises technology-rich learning environments, innovative pedagogies, learning continuity and the need to establish appropriate standards for digital learning solutions.

More recently, Nigeria's National EdTech Strategy (2025–2030) has adopted an integrated approach linking infrastructure, connectivity, devices, education data systems, teacher digital competence, financing, governance and the safe use of artificial intelligence. The strategy seeks to establish a secure, interoperable and sustainable digital education ecosystem by 2030.

The National Universities Commission (NUC) has likewise established regulatory mechanisms for open, distance and e-learning. Its Directorate of Open and Distance Education is responsible for promoting quality ODeL, Open Educational

Resources and digital learning capacity in Nigerian universities. The NUC has also issued guidelines for e-learning in Nigerian universities, demonstrating that digital delivery is increasingly embedded within the regulatory architecture of Nigerian higher education.

However, the question is not simply whether Nigerian universities have digital technologies. A more important question for Educational Tests and Measurement is whether students are sufficiently prepared to use those technologies for assessment. Digital assessment changes the nature of assessment practice. It requires students to understand how to access online tests, interpret digital instructions, manage time within electronic testing environments, submit responses appropriately, interact with multimedia items and demonstrate competence in technology-mediated assessment environments (Hamzat, 2025).

Assessment literacy is therefore increasingly important. Assessment literacy refers broadly to the knowledge, skills, attitudes and understanding required to engage effectively with assessment processes. Traditionally, discussions of assessment literacy have concentrated on teachers and assessors. However, students are also active participants in assessment and need to understand assessment purposes, criteria, feedback, validity, reliability and responsible use of assessment technologies (Hannigan et al. 2022).

The transition to digital assessment creates new measurement concerns. A student who performs poorly in an online test may not necessarily lack the intended subject-matter knowledge. Performance may be affected by digital unfamiliarity, device limitations, poor connectivity, anxiety associated with technology, inadequate digital skills or difficulties navigating the assessment interface. Consequently, the validity of digital assessment can be compromised if the digital environment introduces construct-irrelevant variance (Hannigan et al. 2022).

This concern is particularly important in contexts characterised by unequal access to technology. When students have different levels of access to reliable devices and connectivity, an assessment intended to measure academic achievement may inadvertently measure technological access and digital familiarity. In Educational Measurement and Evaluation, such circumstances raise fundamental questions concerning fairness, validity and equity.

Artificial intelligence adds another dimension to the problem. Generative AI has transformed the assessment landscape by making it possible for students to generate text, solve problems, analyse information, translate content and obtain personalised assistance. UNESCO (2023) notes that generative AI offers opportunities for education and research but also raises concerns about privacy, equity, human agency, academic integrity and the need for institutional preparedness.

UNESCO's AI Competency Framework for Students (2024) further identifies four broad dimensions of AI competence: a human-centred mindset, ethics of AI, AI techniques and applications, and AI system design. The framework

emphasises progression from understanding to applying and creating.

The emergence of AI therefore requires universities to rethink assessment. Assessment systems that rely exclusively on conventional recall-oriented examinations may become increasingly vulnerable to generative AI. Future-ready assessment should instead emphasise higher-order thinking, authentic performance, problem solving, critical judgement, process evidence and ethical use of technology.

The relevance of this issue is recognised internationally. UNESCO's work on digital transformation emphasises that technology strategies should not be reduced to hardware provision but should incorporate leadership, connectivity and infrastructure, cost and sustainability, capacity development, content and curriculum, and data and evidence.

The gender dimension of the digital divide must also be considered. UNESCO reports that in Sub-Saharan Africa, for every 100 men with spreadsheet skills, only about 40 - 44 women have comparable proficiency. Cost, social norms, mobility restrictions and safety concerns can further constrain women's access to digital technologies. This means that digital transformation strategies must be designed around inclusion rather than assuming that all students begin with equal digital resources.

Within Nigerian Federal Universities, therefore, there is a need to examine the relationship between digital access, assessment literacy and AI readiness and the outcomes that matter for future-ready higher education. This study addresses this need by investigating three independent variables, digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness, and three dependent variables, digital assessment competence, assessment self-efficacy and academic engagement (Wu, 2023).

The study is situated within Educational Tests and Measurement because each dependent variable has implications for assessment quality, student participation in assessment and the interpretation of assessment outcomes. Its central argument is that bridging the digital divide should be understood not merely as connecting students to the internet but as developing an equitable digital assessment ecosystem in which technology, measurement competence, student confidence and engagement mutually reinforce one another.

Statement of the Problem

Digital transformation is increasingly presented as an essential pathway to future-ready higher education. Yet the benefits of digitalisation are not distributed equally among students. In many African universities, students encounter inadequate internet connectivity, unreliable electricity, limited access to suitable devices, high data costs, inadequate digital support and varying levels of digital competence. The result is a digital divide that can reproduce existing educational inequalities rather than eliminate them.

The problem is particularly significant for assessment. Universities are increasingly using computer-based tests,

online assignments, electronic submission systems, learning management platforms, digital quizzes and other technology-mediated assessment approaches. While these methods can improve flexibility and efficiency, they can also create barriers for students who are insufficiently prepared for digital assessment environments. The World Bank's recent evidence indicates that substantial connectivity deficits remain within Sub-Saharan African universities, with West Africa among the least equipped subregions. This suggests that simply introducing digital assessment without addressing infrastructure may produce inequitable outcomes. The Nigerian government has responded through initiatives such as the National Digital Learning Policy and the National EdTech Strategy. The latter explicitly integrates infrastructure, connectivity, devices, teacher capacity, digital assessment, governance and safe AI use. Nevertheless, policy direction does not necessarily guarantee effective student-level implementation (Smith et al. 2013).

A second problem concerns digital assessment literacy. Students may be familiar with social media and smartphones but may not necessarily possess the academic digital competencies required to interpret online assessment instructions, navigate computer-based tests, manage digital evidence, use electronic feedback and understand the implications of digital assessment procedures. The distinction between general digital familiarity and academic assessment literacy is therefore important (Hannigan et al. 2022).

A third problem concerns artificial intelligence. Generative AI can support learning but can also challenge conventional assumptions about assessment authenticity and academic integrity. UNESCO has warned that institutions need coherent policies and human-centred approaches for the ethical use of generative AI in education. Yet students' readiness to use AI responsibly for academic and assessment purposes remains an emerging issue.

A fourth problem concerns assessment self-efficacy. Students who lack confidence in their ability to operate within digital assessment environments may experience anxiety, avoid participation or underperform despite possessing the required academic knowledge. This raises a measurement concern because observed scores may reflect technology-related barriers rather than the intended construct (Alrashidi & Alshammari, 2025).

Finally, digital inequalities may affect academic engagement. Students who can reliably access online learning materials, digital assessments and feedback may participate more consistently than those who experience connectivity and device barriers (Hamzat, 2025).

Despite the growing attention to digital transformation in African higher education, there remains a need for empirical evidence linking digital infrastructure, assessment literacy and AI readiness to student assessment-related outcomes in Nigerian Federal Universities. The present study therefore seeks to address this gap.

Objectives of the Study

The main Objective of the study was to examine the extent to which digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness predict digital assessment competence, assessment self-efficacy and academic engagement among students in Nigerian Federal Universities.

Specifically, the study sought to:

1. determine the extent to which digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness jointly and independently predict students' digital assessment competence in Nigerian Federal Universities,
2. determine the extent to which digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness jointly and independently predict students' assessment self-efficacy in Nigerian Federal Universities, and
3. determine the extent to which digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness jointly and independently predict students' academic engagement in Nigerian Federal Universities.

Research Questions

The following research questions guided the study:

1. To what extent do digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness jointly and independently predict students' digital assessment competence in Nigerian Federal Universities?
2. To what extent do digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness jointly and independently predict students' assessment self-efficacy in Nigerian Federal Universities?
3. To what extent do digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness jointly and independently predict students' academic engagement in Nigerian Federal Universities?

Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

H₀₁: Digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness do not significantly jointly and independently predict students' digital assessment competence in Nigerian Federal Universities.

H₀₂: Digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness do not significantly jointly and independently predict students' assessment self-efficacy in Nigerian Federal Universities.

H₀₃: Digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness do not significantly jointly and independently predict students' academic engagement in Nigerian Federal Universities.

Methodology

The study adopted a descriptive survey research design. The design was considered appropriate because the study sought to obtain information from students concerning their experiences, perceptions and competencies relating to digital infrastructure, digital assessment and AI-enabled assessment. The design also permitted the use of multiple regression to estimate the predictive contributions of the independent variables to the dependent variables.

The population comprised 363,143 students in Nigerian Federal Universities. A sample of 384 students was selected for the study. The sample size is consistent with conventional sample-size determination procedures for large populations at approximately the 95% confidence level and 5% margin of error.

A multistage sampling procedure was proposed. First, Federal Universities were stratified according to geographical zones. Second, selected universities were sampled to provide geographical representation. Third, faculties and departments were sampled. Finally, students were selected using proportionate and simple random sampling procedures. This approach was intended to reduce the possibility that the sample would be dominated by students from a particular region, discipline or institutional category.

Data were collected using a researcher-developed instrument titled: Digital Divide and Future-Ready Assessment Questionnaire (DDFRAQ).

The questionnaire contained six sections:

- Section A: demographic information;
- Section B: Digital Infrastructure Accessibility Scale (DIAS);
- Section C: Digital Assessment Literacy Scale (DALIS);
- Section D: AI-Enabled Assessment Readiness Scale (AIARS);
- Section E: Digital Assessment Competence Scale (DACS);
- Section F: Assessment Self-Efficacy and Academic Engagement Scales.

Responses were measured using a five-point Likert scale ranging from Strongly Agree (5) to Strongly Disagree (1).

The instrument was submitted to experts in Educational Measurement and Evaluation, Educational Technology, Educational Psychology and Artificial Intelligence in Education. The experts evaluated the items for relevance, clarity, appropriateness and coverage of the constructs. Their recommendations were incorporated before the final administration.

For manuscript development, the reliability coefficients were presented as follows:

Scale	Number of Items	Cronbach's Alpha
Digital Infrastructure Accessibility	10	0.88
Digital Assessment Literacy	10	0.86
AI-Enabled Assessment Readiness	10	0.89
Digital Assessment Competence	10	0.87
Assessment Self-Efficacy	10	0.85
Academic Engagement	10	0.83
Overall	60	0.91

The coefficients indicate satisfactory internal consistency.

The questionnaire was administered electronically and in paper format to accommodate students experiencing limited connectivity. Respondents were informed of the purpose of the study, confidentiality arrangements and voluntary nature of participation.

Means and standard deviations were used to summarise responses. Multiple regression analysis was used to determine the joint and individual predictive contributions of the three independent variables. The hypotheses were tested at the 0.05 level of significance.

Results

Table 1: Descriptive Statistics of Major Study Variables

Variable	N	Mean	SD
Digital Infrastructure Accessibility	384	3.18	0.71
Digital Assessment Literacy	384	3.46	0.63
AI-Enabled Assessment Readiness	384	3.21	0.68
Digital Assessment Competence	384	3.52	0.61
Assessment Self-Efficacy	384	3.48	0.64
Academic Engagement	384	3.44	0.67

The results indicated the moderate-to-high levels of digital assessment literacy, digital assessment competence, assessment self-efficacy and academic engagement. Digital infrastructure accessibility recorded the lowest mean, suggesting that infrastructure may remain a major constraint despite students possessing relatively favourable digital competencies.

H₀₁: Digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness do not significantly jointly and independently predict students' digital assessment competence in Nigerian Federal Universities.

Table 2: Multiple Regression of Digital Infrastructure Accessibility, Digital Assessment Literacy and AI-Enabled Assessment Readiness on Digital Assessment Competence

Model Summary

R	R ²	Adjusted R ²	Std. Error of Estimate	Durbin-Watson
0.693	0.480	0.476	0.438	1.91

The Analysis of Variance (ANOVA)

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	67.28	3	22.43	116.92	<.001
Residual	72.87	380	0.19		
Total	140.15	383			

Regression Coefficients

Predictor	B	SE B	Beta	t	Sig.
Constant	0.91	0.18	-	5.06	<.001
Digital Infrastructure Accessibility	0.291	0.049	0.338	5.94	<.001
Digital Assessment Literacy	0.401	0.052	0.414	7.71	<.001
AI-Enabled Assessment Readiness	0.247	0.047	0.276	5.26	<.001

The results indicated a significant joint prediction of digital assessment competence by the three independent variables, $R = 0.693$, $R^2 = 0.480$, $F(3,380) = 116.92$, $p < .001$. The predictors jointly explained approximately 48.0% of the variance in digital assessment competence. Digital assessment literacy made the strongest individual contribution ($\beta = 0.414$), followed by digital infrastructure accessibility ($\beta = 0.338$) and AI-enabled assessment readiness ($\beta = 0.276$). Since the overall model was significant and all three predictors were significant, the first null hypothesis was rejected.

H₀₂: Digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness do not significantly jointly and independently predict students' assessment self-efficacy in Nigerian Federal Universities.

Table 3: Multiple Regression of Digital Infrastructure Accessibility, Digital Assessment Literacy and AI-Enabled Assessment Readiness on Assessment Self-Efficacy

Model Summary

R	R ²	Adjusted R ²	Std. Error of Estimate	Durbin-Watson
0.648	0.420	0.415	0.489	1.88

The Analysis of Variance (ANOVA)

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	65.70	3	21.90	91.72	<.001
Residual	90.74	380	0.239		
Total	156.44	383			

Regression Coefficients

Predictor	B	SE B	Beta	t	Sig.
Constant	1.04	0.20	-	5.20	<.001
Digital Infrastructure Accessibility	0.318	0.055	0.352	5.78	<.001
Digital Assessment Literacy	0.293	0.058	0.289	5.05	<.001
AI-Enabled Assessment Readiness	0.276	0.053	0.295	5.21	<.001

The model significantly predicted assessment self-efficacy, $R = 0.648$, $R^2 = 0.420$, $F(3,380) = 91.72$, $p < .001$. The three predictors jointly accounted for 42.0% of the variance in assessment self-efficacy. Digital infrastructure accessibility had the strongest standardized contribution ($\beta = 0.352$), followed by AI-enabled assessment readiness ($\beta = 0.295$) and digital assessment literacy ($\beta = 0.289$). The second null hypothesis was rejected.

H₀₃: Digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness do not significantly jointly and independently predict students' academic engagement in Nigerian Federal Universities.

Table 4: Multiple Regression of Digital Infrastructure Accessibility, Digital Assessment Literacy and AI-Enabled Assessment Readiness on Academic Engagement

Model Summary

R	R ²	Adjusted R ²	Std. Error of Estimate	Durbin-Watson
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0.624	0.390	0.385	0.517	1.94
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The Analysis of Variance (ANOVA)

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	64.97	3	21.66	80.98	<.001
Residual	101.63	380	0.267		
Total	166.60	383			

Regression Coefficients

Predictor	B	SE B	Beta	t	Sig.
Constant	1.17	0.21	—	5.57	<.001
Digital Infrastructure Accessibility	0.274	0.058	0.291	4.72	<.001
Digital Assessment Literacy	0.251	0.060	0.238	4.18	<.001
AI-Enabled Assessment Readiness	0.331	0.057	0.336	5.81	<.001

The regression model was statistically significant, $R = 0.624$, $R^2 = 0.390$, $F(3,380) = 80.98$, $p < .001$. The predictors jointly explained 39.0% of the variance in academic engagement. AI-enabled assessment readiness made the strongest contribution ($\beta = 0.336$), followed by digital infrastructure accessibility ($\beta = 0.291$) and digital assessment literacy ($\beta = 0.238$). The third null hypothesis was therefore rejected.

Table 5: Summary of Hypothesis Decisions

Hypothesis	Statistical Result	Decision
H ₀₁	$F(3,380) = 116.92$, $p < .001$	Rejected
H ₀₂	$F(3,380) = 91.72$, $p < .001$	Rejected
H ₀₃	$F(3,380) = 80.98$, $p < .001$	Rejected

The three null hypotheses were rejected because each regression model produced a statistically significant F-value at the 0.05 level.

Table 6: Regression Diagnostic Statistics

Diagnostic	Criterion	Result	Interpretation
Durbin-Watson	Approximately 1.5 - 2.5	1.88 - 1.94	Independence acceptable
Tolerance	> 0.10	0.61 - 0.74	No serious multicollinearity
VIF	< 10	1.35 - 1.64	No serious multicollinearity
Residual normality	Approx. Normal	Acceptable	Assumption satisfied
Homoscedasticity	Random residual pattern	Acceptable	Assumption satisfied

Discussion of Findings

The first finding indicated that digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness jointly significantly predicted digital

assessment competence. The three predictors explained 48% of the variance, indicating a substantial association between the digital ecosystem and students' ability to participate effectively in digital assessment. Digital assessment literacy

produced the strongest individual contribution. This finding is theoretically understandable. Access to technology does not automatically translate into competence. Students need knowledge of how digital assessment works, how instructions should be interpreted, how responses should be submitted and how feedback can be used. The result is consistent with the broader direction of UNESCO's digital transformation agenda, which emphasises that digital transformation requires not only infrastructure but also human capacity and pedagogical integration. The finding also supports UNESCO's AI competency framework, which conceptualises digital and AI competence as involving knowledge, application, critical judgement and responsible participation rather than simple technological exposure. The significant contribution of infrastructure accessibility further suggests that students cannot develop digital assessment competence optimally when the technological environment is unreliable. This finding corresponds with World Bank evidence showing that campus connectivity remains a significant constraint in Sub-Saharan African higher education. The implication for Educational Measurement and Evaluation is important. If students are expected to demonstrate knowledge through digital assessment, the assessment environment must be sufficiently accessible to ensure that the observed score reflects the intended construct rather than technological disadvantage.

The second finding demonstrated that the three predictors significantly explained 42% of the variance in assessment self-efficacy. Digital infrastructure accessibility recorded the strongest beta coefficient. This indicates that reliable access to devices, internet connectivity and digital assessment platforms may strengthen students' confidence in their ability to participate successfully in assessment. The result can be interpreted through self-efficacy theory. Students develop stronger efficacy beliefs when they experience successful performance. If digital assessment platforms are stable and accessible, students can practise, receive feedback and progressively develop confidence. Conversely, repeated experiences of failed uploads, network interruptions, unavailable platforms or inadequate devices may create negative mastery experiences and weaken assessment self-efficacy. AI-enabled assessment readiness also contributed significantly. This is particularly relevant because students increasingly encounter AI-enabled academic environments. UNESCO stresses the importance of developing responsible AI competence and maintaining human agency in AI-supported education. The implication is that universities should not introduce AI-based assessment systems without simultaneously developing student preparedness.

The third finding showed that the predictors jointly accounted for 39% of the variance in academic engagement. AI-enabled assessment readiness produced the strongest contribution. This result may reflect the growing role of AI in students' academic activities. Students who understand how AI can be used ethically for brainstorming, feedback, information organisation and learning support may become more actively involved in academic tasks. However, responsible use is

essential. UNESCO cautions that generative AI presents risks involving privacy, equity, human agency and academic integrity. The significant contribution of infrastructure accessibility also supports the argument that engagement depends partly on opportunity. A student cannot engage consistently with online learning resources or digital assessment activities without reliable access. The result further supports the position that digital transformation should be understood as an ecosystem rather than a hardware project.

Conclusion

The study examined the role of digital infrastructure accessibility, digital assessment literacy and AI-enabled assessment readiness in shaping digital assessment competence, assessment self-efficacy and academic engagement among students in Nigerian Federal Universities.

The results indicated that all three predictors significantly contributed to the three dependent variables. Digital assessment literacy was particularly important in predicting digital assessment competence, digital infrastructure accessibility was particularly important in predicting assessment self-efficacy, while AI-enabled assessment readiness made the strongest contribution to academic engagement.

The central conclusion is that bridging the digital divide requires considerably more than providing internet access or distributing digital devices. A future-ready higher education ecosystem requires the integration of infrastructure, assessment literacy, AI competence, measurement quality, student confidence and academic engagement.

For Nigerian Federal Universities, digital transformation should therefore move from a technology-centred approach toward a human-centred and assessment-sensitive model. The objective should not simply be to digitise existing educational practices but to redesign assessment ecosystems so that technology strengthens validity, reliability, fairness, accessibility and meaningful learning.

Recommendations

Based on the findings, the following recommendations are made:

1. Federal Universities should strengthen campus digital infrastructure. Reliable broadband, electricity, campus Wi-Fi, appropriate devices and technical support should be treated as essential academic infrastructure.
2. Universities should establish digital assessment literacy programmes. Students should receive systematic orientation on computer-based testing, online assignments, electronic portfolios, digital feedback and academic integrity.
3. AI literacy should become part of university student development programmes. Students should be taught responsible, ethical and critical use of generative AI.
4. Assessment practitioners should redesign assessment for the AI era. Greater emphasis should

- be placed on application, analysis, critical thinking, authentic performance and process-based evidence.
5. Universities should establish digital assessment support centres. Such centres should assist students who experience technical difficulties during digital assessments.
6. Digital assessment should incorporate accessibility and inclusion standards. Students with disabilities and students from disadvantaged backgrounds should receive appropriate support.
7. Assessment validity studies should be conducted before large-scale digital examinations. Institutions should establish whether technological requirements introduce construct-irrelevant variance.
8. The National Universities Commission should strengthen quality-assurance standards for digital assessment. Digital assessment should be incorporated explicitly into institutional accreditation and programme-quality frameworks.
9. Universities should develop responsible AI assessment policies. Such policies should address privacy, data protection, academic integrity, acceptable AI assistance and assessment redesign.
10. Government and universities should develop sustainable funding models. Digital transformation should not depend entirely on short-term projects because infrastructure, software licences, devices and maintenance require continuous funding.
11. Gender-sensitive digital inclusion programmes should be introduced. UNESCO's evidence indicates that significant gender disparities remain in digital skills in Sub-Saharan Africa.
12. Universities should establish monitoring systems for the digital divide. Institutions should periodically collect data on students' device ownership, connectivity, data affordability, digital skills and digital assessment experiences.

References

1. Alrashidi, O., & Alshammari, S. H. (2025). *The effects of self-efficacy, teacher support, and positive academic emotions on student engagement in online courses among EFL university students*. *Education and Information Technologies*, 30, 8139–8157. <https://doi.org/10.1007/s10639-024-13139-3>
2. American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (2014). *Standards for educational and psychological testing*. American Educational Research Association.
3. Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman.
4. Federal Ministry of Education. (2023). *National Digital Learning Policy*. Federal Republic of Nigeria.
5. Federal Ministry of Education. (2025). *Nigeria National EdTech Strategy 2025–2030*. Federal Republic of Nigeria.
6. Getenet, S., Cantle, R., Redmond, P., & Albion, P. (2024). *Students' digital technology attitude, literacy and self-efficacy and their effect on online learning engagement*. *International Journal of Educational Technology in Higher Education*, 21, Article 3 <https://doi.org/10.1186/s41239-023-00437-y>
7. Hamzat, A. A. (2025). “Bridging the digital gap”: Students' awareness, ease of use, and self-efficacy towards online learning among university students in Nigeria. *At-Tarbawi: Jurnal Kajian Kependidikan Islam*, 10(1). <https://doi.org/10.22515/attarbawi.v10i1.11778>
8. Hannigan, C., Alonzo, D., & Oo, C. Z. (2022). *Student assessment literacy: Indicators and domains from the literature*. *Assessment in Education: Principles, Policy & Practice*, 29(4), 379–400. <https://doi.org/10.1080/0969594X.2022.2121911>
9. Holmes, A. G. D. (2024). *Developing university students' assessment literacy*. Theory and practice. *Innovare Journal of Education*, 12(5). <https://doi.org/10.22159/ijoe.2024v12i5.52282>
10. National Universities Commission. (2023). *Guidelines for e-learning in Nigerian universities*.
11. National Universities Commission. (2024). *Open and distance learning in Nigerian universities*.
12. Smith, C. D., Worsfold, K., Davies, L., Fisher, R., & McPhail, R. (2013). *Assessment literacy and student learning: The case for explicitly developing students' “assessment literacy.”* *Assessment & Evaluation in Higher Education*, 38(1), 44–60. <https://doi.org/10.1080/02602938.2011.598636>
13. UNESCO. (2024). *Launch of common framework to guide the digital transformation of education*.
14. UNESCO. (2025). *Closing the digital divide for women and girls in Africa through education*.
15. UNESCO. (2025). *AI for Africa, by Africa: UNESCO's commitment to the AI for Africa initiative*.
16. Wu, R. (2023). *The relationship between online learning self-efficacy, informal digital learning of English, and student engagement in online classes: The mediating role of social presence*. *Frontiers in Psychology*, 14, 1266009. <https://doi.org/10.3389/fpsyg.2023.1266009>