



SUSTAINABLE INCLUSIVE TECHNOLOGY ADOPTION IN NIGERIAN TERTIARY INSTITUTIONS: A CONCEPTUAL FRAMEWORK FOR AI-ENABLED LEARNING SPACES

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ABSTRACT

Nigerian colleges of education and polytechnics are facing persistent barriers to inclusive, AI-enabled learning, including unstable electricity, overcrowded classrooms, scarce devices, limited accessibility provision, and weak data governance. Using a qualitative multiple-case study of three institutions, grounded in documentary and publicly available institutional evidence from a teacher-training college, a polytechnic, and a federal school of statistics, this paper argues that these barriers are structural and participatory rather than purely technological. It contributes the Sustainable Inclusive Technology Adoption Framework (SITAF), a four-layer model spanning infrastructure, digital tools, human experience, and governance, supported by a five-stage implementation roadmap and proposed indicators for pilot testing. The three cases support analytic rather than statistical generalisation, and SITAF has not yet been empirically validated. The findings imply that institutional leaders, sector regulators, and funders must act together on infrastructure standards, accreditation requirements, and data governance if inclusive AI adoption is to survive administrative transitions and reach the learners most at risk of exclusion.

Keywords: Artificial Intelligence, Inclusive Education, Digital Equity, Educational Technology, Data Governance, Nigerian Tertiary Institutions.

Background

A visitor enters a typical classroom in a Nigerian college of education or polytechnic encounters overcrowded spaces, inadequate or non-functional digital equipment, and poor learning conditions that hinder technology-enhanced instruction. This is the reality facing hundreds of thousands of students in institutions that train the teachers and technical professionals essential to Nigeria's development, yet these institutions remain chronically underfunded and underrepresented in educational technology research and policy, while essential infrastructure deteriorates for want of maintenance.

The condition persists despite repeated government initiatives. The One Laptop per Child pilot at LEA Galadima Primary School, Abuja, was the subject of a formative evaluation of its planning and implementation strategies (Ezumah, 2010); it is offered here as a single illustration rather than as a systematic evaluation of national programmes. It nonetheless captures a risk pattern this paper examines throughout: technology deployed without reliable electricity, without local language content, without community ownership, and without the maintenance planning needed for lasting impact. Despite growing interest in artificial intelligence as a transformative force in education, the integration of digital tools into Nigerian polytechnics and colleges of education remains superficial, inconsistent, and inequitably distributed.

The challenge extends beyond the absence of technology to the absence of the conditions for its ethical and effective use: reliable electricity, adequate infrastructure, trained educators, and governance frameworks that protect vulnerable learners such as students with disabilities, girls in



underserved communities, rural learners, minority language speakers, and those from low-income backgrounds. Drawing on case studies of the Federal College of Education (Technical), Omoku; Kwara State Polytechnic, Ilorin; and the Federal School of Statistics, Ibadan, this paper argues that AI-powered inclusive learning spaces can fulfil their potential in these institutions only when ethical adoption is prioritised from the outset and technology strengthens rather than replaces human teaching capacity. Without inclusive design, educator capacity-building, and governance aligned with the Nigeria Data Protection Act 2023 (Nigeria Data Protection Commission [NDPC], 2023), AI adoption may reinforce existing educational inequalities instead of reducing them.

The paper proceeds by reviewing the literature on AI in Nigerian education, inclusive design, staff training, and data ethics; presenting the Sustainable Inclusive Technology Adoption Framework (SITAF), a conceptual model linking the physical, digital, experiential, and ethical dimensions of learning space design. Examining evidence from the three case institutions; analysing data ethics obligations under Nigerian and international law; proposing a five-stage implementation roadmap; and closing with policy implications and scalability. The research gap is therefore clear: existing studies of AI adoption in education largely assume that infrastructure is ready (Wang et al., 2024), assumption Nigerian institutions cannot meet. SITAF is proposed in response.

Research Questions

The study is guided by five questions:

1. What infrastructural, technological, human, and institutional conditions influence the adoption of inclusive digital and AI-enabled learning in the selected institutions?
2. What forms of digital inequality and exclusion are evident among learners, particularly regarding disability, socioeconomic circumstance, access to devices and connectivity, and language?
3. What governance, data-protection, and accountability requirements should inform the implementation of AI-enabled learning systems in this context?
4. What common and institution-specific patterns emerge from a cross-case analysis of the three institutions?
5. How can these conditions and patterns be synthesised into a context-sensitive framework for sustainable, inclusive technology adoption in Nigerian tertiary education?

Objectives

The study pursues five objectives:

1. To identify the infrastructural, technological, human, and institutional conditions that shape the adoption of inclusive digital and AI-enabled learning in the selected institutions.
2. To examine the forms of digital inequality and exclusion experienced by learners, with particular attention to disability, socioeconomic circumstance, access to devices and connectivity, and language.
3. To determine the governance, data-protection, and accountability requirements that should inform the implementation of AI-enabled learning systems in Nigerian tertiary institutions.
4. To identify the common and institution-specific patterns that emerges from the cross-case analysis of the three selected institutions.
5. To synthesise the identified conditions and patterns into a context-sensitive framework for sustainable and inclusive technology adoption in Nigerian tertiary education.

Literature Review

AI in Nigerian Education: Assumptions and Realities



Wang et al. (2024) demonstrate the potential of adaptive learning systems, but their findings presuppose stable digital infrastructure, reliable connectivity, adequate devices, institutional technical support, and digitally literate lecturers and students. These conditions are largely absent in Nigerian public polytechnics and colleges of education, where students face inconsistent internet access, unstable electricity, limited personal devices, and overcrowded learning environments, as the sources described in Section III and examined in Section VI indicate. SITAF's Infrastructure Transformation Layer treats physical and digital readiness as the first condition of equitable AI adoption. Educators are also largely absent from the design of AI in education (Zawacki-Richter et al., 2019).

In Nigerian colleges of education, whose mandate is to prepare future teachers, faculty remains largely marginalised in designing the very tools their graduates will be expected to use. The exclusion is structural rather than incidental: technology is designed for Nigerian educators rather than with them. SITAF's Human Experience Layer treats practitioners' signals as primary inputs to system design rather than afterthoughts. Taken together, these studies reveal a mismatch between the assumptions of AI-in-education research and the material realities of Nigerian polytechnics and colleges of education. The problem is structural, institutional, and participatory rather than primarily technological, and SITAF is designed to address it on all three levels.

Inclusive Design and Marginalised Learners

From available studies we found that most of the colleges of education they in South West Nigeria lacked the necessary assistive technologies and that some of the available equipment was not functional. Bojuwoye (2020), although focused on schools rather than colleges, documents teachers' views on difficulties in implementing inclusive education policy provisions in Nigeria. Documentary evidence from the Federal College of Education (Technical), Omoku, and Kwara State Polytechnic, Ilorin, corroborates and extends this finding. Students with physical disabilities navigate learning environments without assistive devices; students from low-income backgrounds cannot practise curriculum content because laboratories lack functional equipment and institutions provide neither personal devices nor reliable internet access; and students whose first language is not English receive no interpretation support or multilingual learning tools. What is striking is the institutional silence around these absences: the students' struggles are largely unrecorded and do not inform policy decisions. SITAF's Learner Equity principle responds with a structured way to assess accessibility compliance, adaptive learning support, equitable participation, affordability, and whether institutional AI policies accommodate diverse learners.

Staff Training and Data Ethics

Staff training for AI adoption must be institutional, continuous, practical, and mandatory rather than optional or episodic. The literature on technology professional development in sub-Saharan Africa identifies one-time training events as ineffective (Hennessy et al., 2010); yet occasional workshops remain the predominant model in Nigerian tertiary institutions. A sustainable alternative sequences foundational digital literacy before AI-specific applications, is delivered collaboratively by educational technology specialists, teacher educators, institutional ICT units, and regulators such as the National Commission for Colleges of Education (NCCE) and the National Board for Technical Education (NBTE, n.d.), and is supported by workload adjustments, certification, and promotion recognition. It must also accommodate unstable electricity, limited hardware, and large classes. Without this structural realism, as SITAF's educator-capacity dimension holds, AI adoption policies remain theoretical frameworks imposed on impossible conditions.



Formal consent mechanisms exist within Nigerian tertiary institutions, since students must agree to platform terms before access, but their practical meaningfulness may be compromised. Drawing on Solove's (2013) privacy paradox, this paper proposes that many students may not meaningfully read or comprehend the terms they accept; this is a proposition requiring dedicated empirical study, not an established finding. Where consent documents cover algorithmic behavioural profiling, cross-border data transfer, third-party sharing, and indefinite retention, the gap between formal and meaningful consent is a significant compliance risk under the Nigeria Data Protection Act 2023 (NDPA), enforced by the Nigeria Data Protection Commission (NDPC), which requires that consent be freely given, specific, informed, and unambiguous. The problem is structural rather than individual: students at the three case institutions are not failing to protect their data but operating in environments that have not equipped them to do so. SITAF's Accountability and Governance Layer responds by requiring plain-language data summaries, in Nigerian languages where necessary, before any AI-powered platform is deployed.

Methods

This study adopts a qualitative multiple-case study design, drawing primarily on documentary sources and publicly available institutional evidence to examine the factors shaping the adoption of inclusive, AI-enabled learning technologies in Nigerian tertiary institutions. The design was chosen to establish how the interaction between infrastructure, digital tools, human capacity, learner equity, and governance varies across institutions with different mandates and operational contexts; contrasting cases therefore offer a broader understanding of the challenges and opportunities of inclusive AI adoption than a single-case study would. The study does not seek to generalise statistically from the three institutions. Rather, it uses evidence from them to develop the concepts and propositions that inform the proposed SITAF framework.

Case Selection

Three institutions were purposively selected through criterion-based sampling: the Federal College of Education (Technical), Omoku, Rivers State; Kwara State Polytechnic, Ilorin (Kwara Poly); and the Federal School of Statistics, Ibadan (FSS). Each had to meet four criteria:

- i. Recognition as a Nigerian tertiary institution with an established post-secondary or technical-training mandate;
- ii. Existing, documented engagement with digital technologies or ICT infrastructure;
- iii. Meaningful institutional variation (a teacher-training college, a large polytechnic, and a smaller, technology-oriented federal institution), so that recurrence of structural challenges across different mandates could be examined; and
- iv. Sufficient publicly accessible documentary evidence to support systematic examination.

The selection is therefore purposive and illustrative rather than statistically representative of Nigerian tertiary education.

Data Sources and Analysis

Evidence was drawn from four categories of secondary, publicly accessible sources:

- i. Institutional sources, including official websites, reports, and programme descriptions;
- ii. Governmental and regulatory sources, including materials from the NCCE, NBTE, and NDPC;
- iii. Peer-reviewed scholarly literature; and
- iv. Credible media reports, used cautiously and only where official institutional data were unavailable.



Documents were screened for relevance, currency, and credibility and extracted across five analytical domains: infrastructure and readiness; digital tools and utilisation; human experience and capacity; learner equity and inclusion; and governance and accountability. These domains were mapped onto SITAF's four layers, with learner equity treated as a cross-cutting principle rather than a fifth layer (see Section IV). Each case was analysed independently and then compared in a cross-case matrix spanning infrastructure, connectivity, devices, digital systems, staff capacity, student access, accessibility, governance, and evidence source, to identify convergent, divergent, and institution-specific patterns. Claims were triangulated across source types where possible, with greater weight given to primary institutional and governmental sources and with historical figures explicitly distinguished from current ones.

Trustworthiness, Ethics, and Limitations

Because no interviews, questionnaires, or site visits were conducted, all institution-specific claims are documentary rather than field-derived and are presented as evidence-grounded propositions. Individual students were not identified, and marginalised groups were discussed only at an aggregate, institutional level. Three limitations apply:

- i. **Reliance on secondary data.** Publicly accessible documents vary in currency and reliability and may omit undocumented institutional practices; historical figures such as matriculation or graduation counts are not treated as current enrolment data.
- ii. **Purposive sampling.** Three purposively selected cases limit statistical generalisation; findings are analytic propositions for further testing, not national prevalence estimates.
- iii. **An unvalidated framework.** SITAF has not undergone independent empirical validation and requires expert review, pilot testing, or mixed-methods research.

1. Conceptual Framework: The Sustainable Inclusive Technology Adoption Framework (SITAF)

Overview and Foundational Proposition

SITAF is proposed as an original analytical and operational model for understanding and implementing AI-powered inclusive learning spaces in Nigerian tertiary institutions. It functions as a maintenance mechanism: a continuously operating, four-layer system requiring active and coordinated upkeep across interdependent dimensions. Unlike frameworks that treat technology adoption as a single-dimension procurement problem, SITAF holds that infrastructure, digital tools, human experience, and governance must all function at once; the failure of any one layer destabilises the others, reproducing the build-and-abandon pattern this paper argues recurs in Nigerian EdTech initiatives. Implementation follows the five-stage roadmap set out in Section VIII.

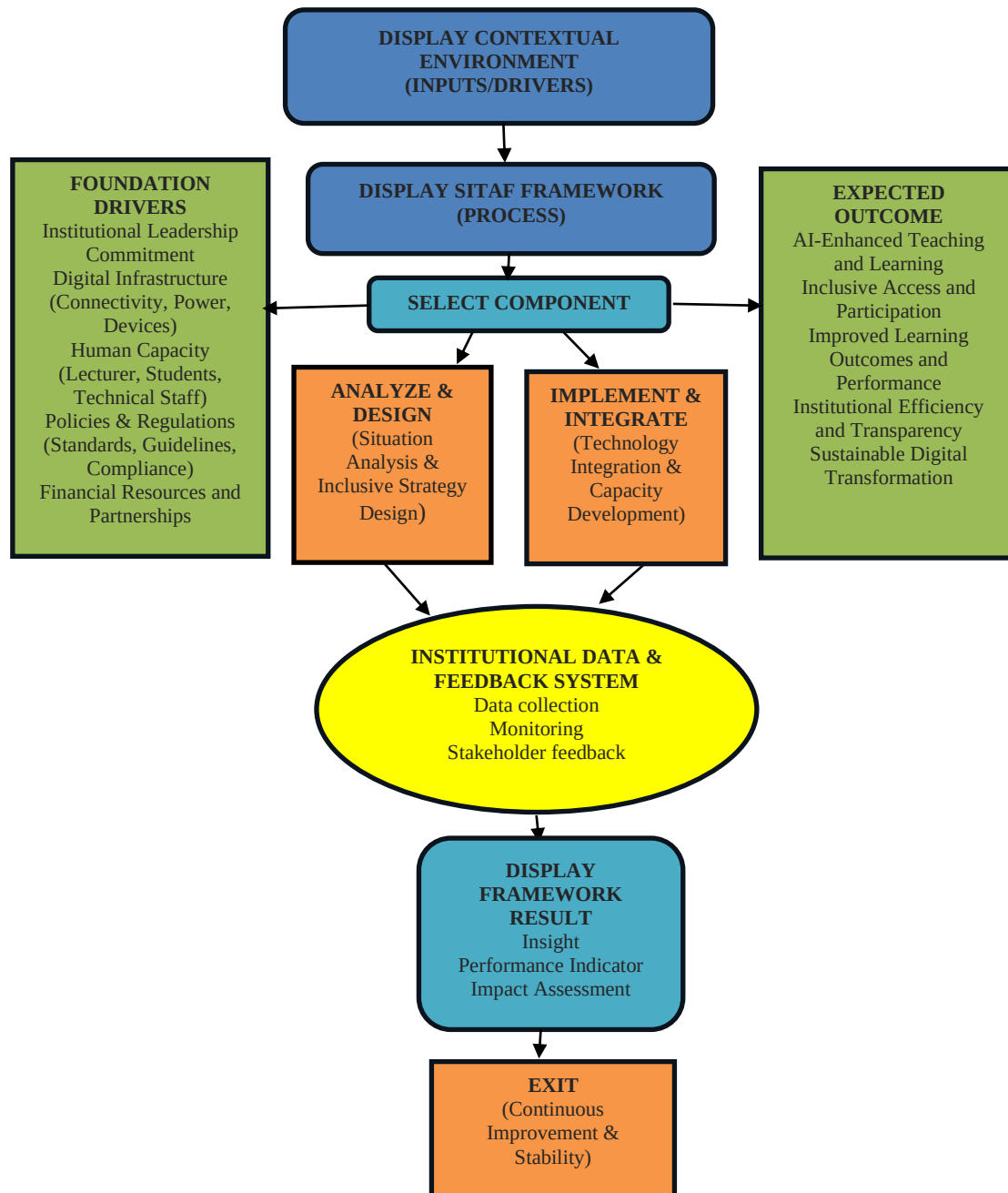


Figure 1. Conceptual framework of the Sustainable Inclusive Technology Adoption Framework (SITAF), showing the four interdependent layers: infrastructure transformation, data and digital tools, human experience, and accountability and governance.

Source: Authors' Design (2026).

SITAF is built on a foundational proposition derived from the institutional evidence examined in this paper: without all four layers functioning together, the concerns of different groups of learners will not carry equal weight in shaping institutional responses. In practice, the voices of the most marginalised students (those with disabilities, girls in underserved communities, rural learners, minority language speakers, and low-income students) will carry less weight in shaping the systems designed to serve them, not because their needs are unimportant but because the structural conditions for their participation have not been established.



SITAF's central contribution is the insistence that sustainable inclusive technology adoption in Nigerian tertiary education is a structural, institutional, and participatory problem rather than primarily a technological one, and that addressing it requires a maintenance mechanism designed for Nigerian institutional conditions rather than the resource assumptions of Global North frameworks.

The Four Layers

Table 1 summarises the four layers and their roles.

Table 1. *SITAF layers and their roles.*

SITAF layer	Role in the framework	Core components
1. Infrastructure Transformation	Provides the physical and digital readiness on which every other layer depends	Power supply, spatial design, device availability, internet access, laboratory functionality
2. Data and Digital Tools	Enables personalised, data-informed learning within ethical limits	Learning management systems, adaptive AI platforms, learning analytics, scheduling systems, data governance
3. Human Experience	Treats student and educator signals as primary inputs to system design	Educator capacity building, student voice mechanisms, culturally responsive design, feedback processes
4. Accountability and Governance	Assigns institutional responsibility for ethical, equitable outcomes	Digital Governance Committee, algorithmic impact audit, student data rights portal, disaggregated outcome reporting

Layer 1: This foundational layer addresses power supply, spatial design, device availability, internet access, and laboratory functionality. No digital learning system can function sustainably without it. Institutions that deploy AI platforms into environments with intermittent electricity and insufficient devices reproduce the deployment-without-readiness failure that has undermined educational technology investment in Nigeria.

Layer 2: This layer concerns how technology generates, processes, and depends on data to personalise and extend learning, through learning management systems, adaptive AI platforms, learning analytics, scheduling systems, and the data governance arrangements that protect student data. It cannot function ethically or effectively without the infrastructure of Layer 1 or the accountability of Layer 4.

Layer 3: This layer treats the signals of students and educators, including lived difficulties, adaptive responses, unmet needs, and professional judgements, as primary inputs into system design. It reframes educator unpreparedness as a sign that Layers 1 and 2 are underdeveloped rather than as resistance, and it encompasses educator capacity building, student voice mechanisms, culturally responsive design, and the feedback processes that keep the maintenance mechanism responsive.

Layer 4: This layer assigns institutional responsibility for ethical outcomes, equitable distribution of benefit, data protection compliance, and monitoring of whether SITAF's well-being indicators are being met. Its instruments are a Digital Governance Committee, an annual algorithmic impact audit, a student data rights portal, and disaggregated outcome reporting that protects against equity washing, the adoption of inclusive language without inclusive structural change.

Data Protection Mechanisms for Equity Audits



Because disaggregation by gender, disability, ethnicity, language, location, and socioeconomic status involves categories that the NDPA treats, or may be read to treat, as sensitive personal data, such audits should be designed with data minimisation, an appropriate lawful basis, aggregation and anonymisation or pseudonymisation of reported results, restricted access controls, defined retention limits, and institutional ethical approval, rather than routine collection or retention of individually identifiable sensitive attributes. Section VII elaborates these obligations.

Measuring Student Well-Being in AI-Enhanced Environments

A Multidimensional Metrics Framework

Measuring the impact of AI-powered learning spaces on student well-being requires a framework that resists reduction to academic performance metrics alone. SITAF proposes five domains (cognitive, social-emotional, physical, cultural belonging, and academic agency), each with indicators and data sources, as shown in Table 2. These are proposed indicators for pilot testing rather than fixed benchmarks. No baseline study or statistical rationale currently supports numerical targets, so none are set here; institutions should establish baselines during pilots (Stage Four) and calibrate targets and review cycles against their own data.

Table 2. *SITAF student well-being indicators proposed for pilot testing.*

Well-being domain	Key indicators	Data source	Proposed review cycle
Cognitive	Task completion, quiz scores, time-on-task	LMS analytics	Monthly
Social-emotional	SEL survey scores, peer interaction frequency	SEL surveys, LMS discussion data	Termly
Physical	Air quality, noise levels, attendance	IoT sensors, attendance records	Weekly
Cultural belonging	Language accessibility, content representation	Platform audits, student surveys	Semesterly
Academic agency	Goal-setting frequency, self-assessment use	LMS dashboards, portfolios	Monthly

Mental Health, Belonging, and the Consent Gap

Mental health presents a particular measurement challenge in Nigerian educational contexts. Stigma around mental illness, limited counselling services and the absence of validated culturally-adapted instruments mean that administrative data on mental health is both sparse and unreliable. AI-powered early warning systems, which analyse patterns such as declining LMS engagement, sudden drop-offs in submission frequency, or changes in the sentiment of discussion forum contributions, offer a proxy pathway to identifying distressed students that does not rely on self-disclosure.

Such systems also carry a substantial risk of false positives, unwarranted profiling, and surveillance, and behavioural indicators of this kind should never be treated as a diagnosis of a mental health condition. Any such system requires documented model validation, defined false-positive tolerances, and mandatory human review before any consequential action is taken on a flagged student. Where these indicators inform a solely automated decision affecting a student, NDPA Section 37 requires safeguards including the possibility of human intervention and the student's right to contest the decision, so institutions should build explainability, contestability, and human oversight into the process from the outset rather than as an afterthought.

The deployment of such systems nevertheless raises acute consent concerns. Drawing on Solove's (2013) privacy-paradox literature, this paper proposes, as a proposition requiring



dedicated empirical investigation rather than an established Nigerian statistic, that many students at Nigerian tertiary institutions may not meaningfully read or comprehend platform terms before accepting them. If confirmed, this gap between formal and meaningful consent would not be a procedural technicality but a fundamental rights issue addressed directly by the Nigeria Data Protection Act 2023, which requires that consent to sensitive data processing be freely given, specific, informed, and unambiguous. SITAF's Accountability and Governance Layer therefore requires institutions to provide plain-language summaries of all data collection activities, including AI-generated behavioural profiles, in formats accessible to students at all literacy levels and in Nigerian languages where relevant.

Case Studies: Digital Inclusion in Nigerian Tertiary Institutions

A. Federal College of Education (Technical), Omoku, Rivers State

The Federal College of Education (Technical), Omoku, Rivers State (FCET OMOKU), established in 1989, is a federal-owned teacher-training institution awarding NCE certificates and B.Sc. Ed, B.Ed, and B.Tech. Ed degrees across technical, vocational, science, and arts fields, with affiliation to the University of Nigeria, Nsukka (UNN) and the University of Uyo (UNIUYO) (Federal College of Education (Technical), Omoku, Rivers State, n.d.). A current, officially sourced enrolment figure was not available at the time of writing, so enrolment-based statements about this institution are treated as propositions rather than established facts.

Digital infrastructure exists at FCET OMOKU but in fragmented and unevenly functional forms rather than as an integrated institutional ecosystem. Online registration and payment portals, departmental computer science and educational technology programmes, a modernised library, ICT-related teaching facilities, and affiliated degree coordination systems all formally exist. Yet classroom space remains inadequate, and facilities struggle to keep pace with enrolment growth. This is the partial deployment without systemic foundation that SITAF identifies: digital tools exist as isolated components rather than as a coordinated, campus-wide ecosystem capable of supporting all students equitably.

The most visibly underserved population is student-teachers from economically disadvantaged backgrounds, particularly those in high-enrolment programmes who lack consistent access to laptops, connectivity, or personal digital learning resources. Students with disabilities are also significantly underserved, as inclusive technologies, accessibility infrastructure, and adaptive learning systems remain limited across most Nigerian colleges of education. Both groups experience what SITAF's Learner Equity principle identifies as invisible exclusion: structural barriers that do not appear in institutional records because the institution has not developed mechanisms to detect or document them.

The single most consequential argument for urgent intervention at FCET OMOKU is the institutional multiplier effect. Because the college exists to train teachers, every technological weakness within it eventually reproduces itself in the future classrooms its graduates will teach in. A student-teacher who completes an NCE programme without meaningful digital pedagogy experience does not merely graduate underprepared; they carry that experience into Nigerian primary and secondary classrooms, where it shapes the learning of the next generation. Digital failure at FCET OMOKU is therefore not an institutional problem contained within its campus but a systemic problem that reproduces itself across successive cohorts of graduating teachers.

B. Kwara State Polytechnic, Ilorin

Kwara State Polytechnic (Kwara Poly) illustrates the gap between institutional digital ambition and operational reality. The institution reported 7,781 graduates from its ND and HND programmes



at its 28th convocation (Akanbi, 2022); while this is a graduation figure rather than a direct measure of current enrolment, it nonetheless indicates a student population of considerable scale across dozens of accredited programmes. A current enrolment figure was not available at the time of writing. It is not a technologically absent institution: CBT examination centres, e-library facilities, ICT-related programmes, entrepreneurship digital training, and an Open Distance Flexible E-Learning initiative all formally exist, and solar support has been reported for some campus facilities. On paper, Kwara Poly possesses the architectural components of a functional digital learning environment.

Yet the scale of demand on Kwara Poly's digital facilities is difficult to establish from public documents. The polytechnic's published CBT timetable schedules examinations at designated CBT centres in 20-minute sessions per course (Kwara State Polytechnic, n.d.), but no independently verifiable record of CBT capacity relative to enrolment could be located. Capacity relative to enrolment is therefore treated as a proposition to be audited rather than an established deficit, and it is the first condition that SITAF's Infrastructure Transformation Layer asks institutions to examine before any AI-powered inclusive learning initiative is introduced.

Where such capacity is limited, the inequity dimension of infrastructure failure becomes visible. If digital access is rationed by physical competition for limited places, the students least able to compete are precisely those SITAF's Learner Equity principle is designed to protect: students with physical disabilities, pregnant women, students experiencing anxiety-related difficulties, and students from rural areas unfamiliar with navigating institutional systems. Infrastructure failure is never neutral in its effects: it reproduces and amplifies the exclusions already present in the social environment.

The most transformative change at Kwara Poly would be a coordinated, institution-wide digital learning ecosystem built around reliability, accessibility, and staff support: stable electricity, campus-wide affordable internet access, properly maintained learning platforms, continuous lecturer training, and infrastructure designed around actual enrolment numbers rather than symbolic technology adoption. Without that systemic foundation, isolated ICT projects will remain what they currently are: fragmented, overstretched, and chronically underutilised.

C. Federal School of Statistics (FSSIB)

The Federal School of Statistics presents the most theoretically significant case study of the three, precisely because it should be an exception to the pattern seen at the other two institutions. FSS offers programmes across six academic disciplines, including dedicated programmes in Statistics, Computer Science, Artificial Intelligence, and Networking and Cloud Computing (Federal School of Statistics Ibadan, n.d.), with a relatively small student population by comparison with FCET OMOKU and Kwara Poly; an official enrolment figure was not available at the time of writing. FSS is an institution whose entire academic identity is built around data, digital systems, and computational thinking. If any Nigerian tertiary institution were positioned to model AI-powered inclusive learning, it should be this one.

This paper proposes, as a hypothesis consistent with the general pattern documented at FCET OMOKU and Kwara Poly but not yet confirmed by FSS-specific audit data, that FSS may reproduce a similar structural pattern despite its federal funding, smaller enrolment, and technology-oriented mandate. Digital capacity may be concentrated within core computing disciplines, with students outside those disciplines and economically disadvantaged students potentially experiencing more limited access to updated hardware, stable connectivity, licensed software, and practical laboratory time. Students with disabilities are likely to remain underserved, consistent with the broader Nigerian pattern in which specialised accessibility technologies remain



uncommon regardless of an institution's academic orientation; institution-specific verification of these propositions would strengthen this case.

A plausible explanation for this paradox lies in four potentially intersecting institutional challenges: budget allocation that may prioritise departmental prestige over institution-wide equity; departmental silos that prevent digital resources from reaching students outside core technical programmes; possible policy gaps at both institutional and federal levels in mandating inclusive digital access as a baseline standard; and managerial limitations that allow digital infrastructure to deteriorate without accountability. An institution that awards qualifications in Artificial Intelligence but cannot guarantee every student access to a functioning device is not suffering from a technology deficit alone; it points to a governance-related limitation. SITAF's Accountability and Governance Layer addresses this directly by requiring institution-level digital equity audits, transparent resource allocation reporting, and mandatory accessibility compliance across all departments.

Cross-Institutional Analysis

Examined individually, each institution presents a distinct profile of digital inequality. FCET OMOKU's deficit is primarily one of scale and maintenance governance; Kwara Poly's deficit is one of infrastructure capacity relative to enrolment demand; and FSS's deficit is primarily one of institutional equity, the failure to distribute digital access across departmental boundaries. Examined together using the cross-case comparison outlined in Section III, however, the three reveal a pattern that transcends their individual differences.

Despite their differences in size, funding, and mandate, the three institutions share a condition that appears, on the documentary evidence examined in this paper, to most fundamentally limit AI-powered inclusive learning: the absence of a stable, institution-wide digital ecosystem capable of supporting equitable access, consistent infrastructure, trained educators, and sustainable technology integration for all categories of learners. Because this observation is drawn from three purposively selected cases rather than a representative sample, it is offered as an analytic proposition about a possible pattern rather than a statistically generalisable finding across Nigerian tertiary education.

This shared condition is not accidental. It reflects a systemic pattern in Nigerian educational technology policy, the same pattern this paper associates with the OLPC pilot discussed in the Background, in which technology has repeatedly been introduced without the maintenance funding, staffing, and governance structures needed to sustain it as a functional system. Until Nigerian tertiary institutions, their regulatory bodies, and their funding agencies treat sustainable digital ecosystems as non-negotiable institutional infrastructure rather than optional enhancement, AI-powered inclusive learning will remain a policy aspiration rather than a classroom reality.

Data Ethics, Privacy, and the Governance Imperative

The Nigeria Data Protection Act 2023

The Nigeria Data Protection Act 2023 (NDPC, 2023) marks a watershed in Nigerian data governance. By establishing the independent NDPC and expanding the category of sensitive personal data to include biometric, genetic, health, ethnic, and religious information, the NDPA creates a framework that, if effectively enforced, would substantially constrain the most privacy-invasive applications of AI in Nigerian educational settings. Under Section 28, Data Protection Impact Assessments (DPIAs) are required where processing is likely to result in high risk to the rights and freedoms of data subjects; this is not an automatic requirement for every AI system, but it is reasonably read to capture high-risk applications such as sustained AI behavioural monitoring



of students, facial recognition attendance systems, and continuous biometric sensing in classrooms, subject to the Act and applicable regulatory guidance.

The NDPA's requirement for a lawful basis for processing is significant for educational AI in two respects. First, Section 25 recognises several lawful bases beyond consent, including performance of a contract, legal obligation, protection of vital interests, public interest or official authority, and legitimate interests. Consent is problematic as the primary basis where students may feel coerced into consenting as a condition of access; institutions should therefore ground ordinary processing on legitimate interest, contract, or legal obligation where appropriate, while recognising that processing of sensitive personal data generally requires a stronger basis, accompanied in all cases by robust transparency obligations. Second, the cross-border transfer provisions (Sections 41–43) do not categorically prohibit transfers to platforms hosted outside Nigeria; they permit transfers where the destination offers an adequate level of protection or other recognised grounds apply, such as appropriate contractual safeguards, subject to the Commission's guidance. This matters in practice because Moodle, Google Classroom, Canvas, and Microsoft Teams are among the most used platforms in the sector, and institutions should assess the safeguards each vendor offers rather than assume that server location alone determines compliance.

FERPA and GDPR as Reference Frameworks

While the Family Educational Rights and Privacy Act (FERPA, 1974) applies directly only to US institutions, its principles may serve as a reference standard because many major EdTech vendors are US-incorporated and commonly reference FERPA in their contractual terms. Under FERPA, educational records including AI-generated behavioural profiles may only be shared with third parties with student consent or under a defined set of exceptions. FERPA's application to online learning environments and AI-generated records continues to develop, so Nigerian institutions using US-developed adaptive platforms should monitor official US Department of Education guidance rather than treat any extension of protections as settled. Cybersecurity incidents in the education sector remain a documented and growing concern globally, underscoring the urgency of FERPA-aligned security practices in Nigerian EdTech deployments.

The General Data Protection Regulation (GDPR, 2016) contributes documentation requirements (Records of Processing Activities, Data Processing Agreements with all vendors, and Data Protection Impact Assessments for high-risk processing) that can be adopted within the Nigerian institutional context through the NDPA's analogous provisions and create an accountability infrastructure extending beyond technical security to the purposes, effects, and community oversight of AI systems. This paper argues that Nigerian tertiary institutions should treat these requirements not as bureaucratic compliance exercises but as instruments of democratic accountability to the student communities whose data is being processed.

An Ethics-by-Design Framework for Nigerian Educational AI

Ethics-by-design, as articulated by Floridi and Cowls (2019) through their five principles for AI in society (beneficence, non-maleficence, autonomy, justice, and explicability), provides a normative architecture for governing educational AI in Nigeria. A practical framework for Nigerian institutions should include: a cross-functional Digital Governance Committee with mandatory student and community representation; a public-facing AI transparency register documenting all deployed systems, their data inputs, decision outputs, and review dates; a student data rights portal enabling access, correction, and deletion requests in compliance with the NDPA; and an annual algorithmic impact audit assessing whether AI-generated recommendations have had disparate impacts on students disaggregated by gender, disability, ethnicity, language, location, and socioeconomic status.



2. Implementation Roadmap: Applying SITAF Across Nigerian Tertiary Institutions

The implementation of AI-powered inclusive learning spaces in Nigerian colleges of education and polytechnics cannot follow the linear, resource-abundant rollout models proposed in Global North educational technology literature. Nigerian institutions operate within constraints of unstable electricity supply, chronic underfunding, leadership-dependent change cultures, and deeply entrenched manual administrative systems that demand a sequencing logic grounded in institutional reality. The five-stage roadmap proposed here draws on the documentary evidence from the three cases and on documented patterns of technology adoption in Nigerian education, and is structured around the four layers of SITAF.

Stage One: Infrastructure Stabilisation

No AI-powered learning system can function sustainably in an environment where electricity is unreliable, internet access is unaffordable or unavailable, computer laboratories are broken or insufficient, and students lack access to basic computing devices. Infrastructure stabilisation at this stage includes installing or upgrading solar hybrid power systems to reduce dependency on the national grid, establishing campus-wide affordable Wi-Fi infrastructure, procuring or rehabilitating computer laboratories scaled to actual enrolment rather than symbolic capacity, and providing shared institutional devices for students who cannot afford personal hardware.

This stage corresponds to SITAF's Infrastructure Transformation Layer, which holds that physical and digital readiness is not a background assumption but the first condition of equitable technology adoption. Institutions that attempt to skip it while deploying AI platforms into environments without stable electricity or sufficient devices will reproduce the same build-and-abandon failure pattern that has characterised Nigerian EdTech policy in initiatives such as the OLPC pilot. Infrastructure stabilisation is not preparation for the real work. It is the real work.

Stage Two: Leadership Commitment and Policy Alignment

Nothing moves sustainably in Nigerian tertiary institutions unless institutional leadership treats it as a priority. Technology projects framed as ICT department responsibilities rather than institutional strategic priorities remain underfunded, understaffed, and vulnerable to leadership changes. Sustainable AI adoption requires the visible, documented, and resource-backed commitment of rectors, provosts, deans, and heads of department.

At this stage, institutions must develop formal digital inclusion policies aligned with the Nigeria Data Protection Act 2023, the National Policy on Inclusive Education (Federal Ministry of Education, 2023), and the regulatory frameworks of the NCCE or NBTE as applicable. A cross-functional Digital Governance Committee comprising academic leadership, ICT staff, student representatives, disability services, and an independent Data Protection Officer should be established with a formal mandate, meeting schedule, and published terms of reference. Leadership commitment without governance structure produces enthusiasm without accountability. Both are required.

Stage Three: Educator Capacity Building

The third stage addresses what is most frequently misdiagnosed as teacher resistance but more accurately reflects structural unpreparedness. As Layer 3 holds, what is often characterised as resistance is more precisely a signal that the Educator Capacity dimension of the Human Experience Layer has not been developed, and that technology has been deployed ahead of the conditions that make adoption genuinely possible. Ertmer's (1999) distinction between first-order barriers (resources, training, and support) and second-order barriers (beliefs and established



practices) is relevant here: SITAF treats first-order barriers as the precondition for addressing second-order ones.

Capacity building at this stage follows a deliberate sequence. Foundational digital literacy must be established before AI-specific applications are introduced. Training must be delivered collaboratively by educational technology specialists, teacher educators, institutional ICT units, external AI professionals, and regulatory agencies. It must be mandatory rather than optional, supported by workload adjustments, certification, and promotion recognition. Sessions must be designed around Nigerian institutional realities: unstable electricity, inconsistent internet access, limited hardware, and large classroom sizes. Critically, training must prepare lecturers not merely to use AI tools but to teach students to engage with AI critically and responsibly, redesigning assessments and classroom activities to account for AI-assisted learning rather than defaulting to prohibition. This dimension is particularly urgent in colleges of education, where today's student-teachers will become tomorrow's classroom practitioners.

Stage Four: Controlled Pilot and Evidence Generation

Rather than mandating institution-wide AI adoption simultaneously, Stage Four begins with controlled departmental pilots. Two or three departments, selected for their combination of willing faculty, manageable class sizes, and reasonable infrastructure readiness, implement AI-supported learning tools within a structured evaluation framework. Pilot evaluation must measure outcomes across all five SITAF well-being dimensions. The evidence generated serves two institutional functions at once: it provides data for genuine programme improvement, and it provides the proof of concept that reduces what appears as resistance among unconvinced colleagues, because in Nigerian institutional culture, demonstrated local success is more persuasive than imported theoretical evidence.

Stage Five: Institutional Embedding and Sustainability

The final stage addresses the condition that has most consistently caused Nigerian EdTech initiatives to fail: the inability to survive beyond their initial funding cycle, champion leader, or policy moment. For SITAF to function as a maintenance mechanism rather than a procurement event, AI-supported teaching must become embedded in the normal rhythms of institutional life; in course registration systems, teaching quality frameworks, academic supervision processes, accreditation self-studies, and staff performance appraisals.

Embedding requires three specific institutional decisions. First, digital inclusion metrics must be incorporated into institutional accreditation processes monitored by NCCE and NBTE, creating external accountability for sustainability. Second, recurrent budget lines, rather than one-off capital allocations, must fund technology maintenance, software licensing, staff training, and device replacement on predictable cycles. Third, student data governance must be reviewed annually by the Digital Governance Committee, with findings published in accessible formats available to the student body.

Critical Analysis: Limitations, Risks, and Honest Reckoning

The SITAF framework and its accompanying five-stage roadmap represent a coherent, evidence-informed proposal for AI-powered inclusive learning in Nigerian tertiary institutions. Intellectual honesty demands, however, that any serious argument account for the conditions under which its own proposals could fail. Three categories of risk require direct engagement.

Leadership Discontinuity and Institutional Politics

A potentially significant implementation risk to the SITAF roadmap in a real Nigerian institution may lie less in technological inadequacy, funding shortage, or staff unwillingness than in



leadership discontinuity combined with institutional politics. Projects succeed or collapse depending on whether a particular rector, provost, dean, or director personally champions them. When leadership changes through retirement, political appointment, removal, or election, priorities change with it, and ongoing initiatives lose protection, funding, attention, administrative momentum, and political backing.

This pattern is consistent with the Nigerian educational reform literature. Okoroma (2006), in a literature-based review of Nigerian education policy, attributed ineffective implementation primarily to lack of political will, lack of continuity of programmes, and corruption.

SITAF's response to this risk is Stage Five's embedding strategy: the deliberate integration of digital inclusion metrics into accreditation processes, recurrent budget lines, and staff appraisal frameworks that survive individual leadership cycles. This paper acknowledges, however, that embedding alone cannot fully insulate institutional reform from political discontinuity in contexts where regulatory bodies such as NCCE and NBTE do not consistently enforce their own accreditation standards.

The Infrastructural Dependency Problem

The SITAF roadmap places infrastructure stabilisation as Stage One, a sequencing decision grounded in the argument that no digital learning system can function without reliable electricity, internet access, and sufficient devices. This sequencing is pedagogically and technically sound. It is also, in many Nigerian institutional contexts, potentially indefinite: the conditions Stage One requires demand capital investment that funded institutions such as FCET OMOKU and Kwara State Polytechnic have not historically been able to generate or sustain. The response is not to lower the infrastructure standard but to develop parallel funding strategies, including public-private partnerships of the kind piloted in Edo State's collaboration with Microsoft ("EdoJobs," 2018), Tertiary Education Trust Fund (TETFund, n.d.) grants directed at infrastructure rehabilitation, and phased donor partnerships coordinated through the National Information Technology Development Agency's (NITDA, n.d.) 3 Million Technical Talent (3MTT) initiative. These are cited as illustrative models rather than evaluated interventions; readers seeking to replicate them should consult the relevant state government, TETFund, and NITDA documentation directly, as the present paper has not audited their outcomes.

The Risk of Equity Washing

Equity washing occurs when institutions adopt the language of inclusive design without making the structural changes those terms require. In AI-powered learning spaces, it might look like an institution that procures an adaptive learning platform, publishes a digital inclusion policy aligned with NDPA 2023, and reports improved technology utilisation metrics while students with disabilities still navigate inaccessible physical spaces, students from low-income backgrounds still lack personal devices, and minority language speakers still receive no multilingual support. SITAF's protection against equity washing is its insistence on disaggregated outcome measurement: well-being metrics must be reported not only for the student population as a whole but specifically for the five marginalised groups identified in this paper. Where an institution cannot demonstrate measurable improvements for these populations, the Accountability and Governance Layer requires suspension and review of the relevant tools rather than continuation under a veneer of inclusive language.

Discussion and Policy Implications and Conclusion

This section interprets the cross-case evidence, shows how SITAF aligns with and extends Nigeria's National Policy on ICT in Education (Federal Ministry of Education, 2019) and



UNESCO's guidance on AI in education, and sets out implications for regulators and for settings beyond Nigeria.

Interpreting the Cross-Case Evidence

The three cases point to a common explanation: the binding constraint on inclusive AI adoption is the absence of a stable, institution-wide digital ecosystem, not the absence of tools. FCET OMOKU shows deficits of scale and maintenance governance, Kwara Poly shows infrastructure capacity relative to enrolment demand, and FSS, a computing-oriented institution, is hypothesised to show that a technical mandate alone does not guarantee equitable access across departments. Read through SITAF, each is a failure of layer interdependence: digital tools exist (Layer 2) without the infrastructure (Layer 1), the trained and consulted educators (Layer 3), or the accountable governance (Layer 4) that would let them serve all learners. Because the evidence is documentary and drawn from purposively selected cases, these readings are analytic propositions for testing, not prevalence findings.

Alignment with Nigeria's National Policy on ICT in Education

The 2019 policy envisions education that is universally accessible, empowering, inclusive, and enriching, and it defines universal accessibility as removing barriers to learning before they can affect anyone (Federal Ministry of Education, 2019). It organises its provisions into seven focus areas, four of which, together with its vision, map directly onto SITAF (Table 3).

Table 3. *Alignment between the National Policy on ICT in Education and SITAF.*

Policy focus area	What the policy provides	SITAF layer and contribution
Infrastructure (sec. 7.2)	A common ICT infrastructure platform for education at all levels; cost-effective and sustainable alternative power supply; technical support, maintenance, and business continuity	Layer 1 turns these provisions into an institutional readiness gate that must be passed before AI tools are introduced (Stage One), and treats maintenance as continuous work
Human capital development (sec. 7.1)	Continuous and mandatory professional development; continuing ICT training for all staff; ICT proficiency with special focus on people with special needs	Layer 3 adds AI-specific, sequenced educator training and treats educator signals as design inputs rather than resistance
Governance (sec. 7.5)	A legal, regulatory, and security framework; standards and guidelines; accreditation and monitoring of ICT programmes and institutions	Layer 4 adds an institutional Digital Governance Committee, an algorithmic impact audit, and NDPA-aligned data practices for AI platforms
Monitoring and evaluation (sec. 7.7)	M&E to track implementation, service delivery, and compliance, with impact assessment of the policy	Layer 4 and Section V add disaggregated well-being indicators that institutions can pilot-test locally
Vision and definitions (sec. 2.0)	Education that is universally accessible, empowering, inclusive, and enriching; barriers to learning removed before they affect anyone	The Learner Equity principle adds a structured audit of accessibility, affordability, and language support

Three points of convergence deserve emphasis. First, the policy's own diagnosis of implementation challenges, which includes inadequate policy implementation, teachers who are not yet proficient in ICT, inadequate infrastructure in some institutions, urban-rural and public-private equity gaps that extend to power supply, and inadequate funding (Federal Ministry of Education, 2019, sec. 1.1.2), closely mirrors the structural barriers documented at the case institutions. Second, because education sits on the Concurrent Legislative List, the policy notes that implementation rests heavily on state and local governments, precisely where a maintenance mechanism operating



at institutional level is needed. Third, the policy names the NCCE, the NBTE, and the National Universities Commission (NUC), working with the Computer Professionals Registration Council of Nigeria, as regulators of IT education at tertiary level, which gives SITAF's accreditation-based embedding (Stage Five) an existing institutional route.

SITAF also extends the policy in two respects. The policy text does not address artificial intelligence or personal data protection, and it was approved well before generative AI tools became widely available and before the Nigeria Data Protection Act 2023. Its financing provision also allocates at least 5% of the annual education capital budget to ICT in education (sec. 7.6), a capital-oriented formula, whereas SITAF's maintenance logic implies recurrent budget lines for repairs, power, and training. These are the areas where SITAF can supply institutional guidance through the policy's implementation guidelines and any future revision.

Alignment with UNESCO's Guidance on AI in Education

UNESCO's guidance on generative AI in education and research takes a human-centred position. It identifies risks to human agency, inclusion, equity, gender equality, and linguistic and cultural diversity; sets out seven steps for governments to regulate generative AI, beginning with data protection regulation and including capacity building in educational institutions (Miao & Holmes, 2023, sec. 3.2); and stresses that institutions must validate AI systems for ethical and pedagogical appropriateness, while observing that the absence of national regulation leaves them largely unprepared to do so. UNESCO's companion competency framework for teachers ties teacher preparation to inclusivity, human agency, non-discrimination, and respect for linguistic and cultural diversity (Miao & Cukurova, 2024). Table 4 maps these provisions onto SITAF.

Table 4. *Alignment between UNESCO's AI in education guidance and SITAF.*

UNESCO emphasis	UNESCO source	SITAF response
Protect human agency; consult teachers and learners before deciding whether and how to deploy tools	Miao & Holmes (2023), sec. 4.2	Layer 3 treats student and educator signals as primary design inputs; Stage Three prepares lecturers to teach critical engagement with AI
Audit and validate AI systems for bias, ethics, and pedagogical appropriateness before institutional adoption	Miao & Holmes (2023), secs. 3.3.3 and 4.3	Layer 4 algorithmic impact audit and Digital Governance Committee; Stage Four controlled pilots before wider adoption
Protect data privacy; endorse or develop data protection regulation (Step 1)	Miao & Holmes (2023), secs. 3.2 and 3.3.1	Layer 2 data governance; Layer 4 plain-language data summaries, student data rights portal, and NDPA-aligned equity audits (Section VII)
Promote inclusion, equity, and linguistic and cultural diversity, including affordable connectivity	Miao & Holmes (2023), sec. 4.1; Miao & Cukurova (2024)	Learner Equity principle, Layer 1 access and affordability, and Layer 3 culturally responsive design; disaggregated reporting as a safeguard against equity washing
Build capacity for teachers and institutions (Step 6)	Miao & Holmes (2023), secs. 3.2 and 4.5; Miao & Cukurova (2024)	Layer 3 and Stage Three: continuous, practical, mandatory training sequenced from digital literacy to AI applications
Test locally relevant models and build an evidence base through co-designed piloting	Miao & Holmes (2023), secs. 4.7 and 5.3	Stage Four controlled departmental pilots using the five-domain indicators proposed in Section V



UNESCO itself recognises the readiness problem: Step 6 holds that institutions must first build the capacity to understand the benefits and risks of AI before they can validate its adoption, and the guidance warns of worsening digital poverty and calls for action on connectivity (Miao & Holmes, 2023, secs. 2.1 and 4.1). It presents these, however, as policy actions for governments across many settings, not as an ordered sequence for individual institutions. SITAF's contribution is to turn them into institution-level preconditions: stabilise infrastructure, build educator capacity, and establish governance, and only then pilot AI tools, with each element maintained continuously.

Informing Regulatory Bodies

Because the national policy already assigns regulation of tertiary IT education to the NCCE, NBTE, and NUC, SITAF can inform three regulators in distinct ways:

- i. **NCCE (colleges of education):** It could build digital pedagogy, inclusive technology training, and AI readiness into teacher-training accreditation standards across all departments, not only computer-related programmes.
- ii. **NBTE (polytechnics and technical institutions):** It could adopt minimum standards for infrastructure, connectivity, and accessibility, together with a digital inclusion indicator set, as part of accreditation, which is the embedding mechanism proposed in Stage Five.
- iii. **NDPC (data protection):** It could issue sector guidance on when data protection impact assessments apply to educational AI, on plain-language data summaries for students, and on safeguards for sensitive attributes in disaggregated equity audits.

Scalability beyond Nigeria

SITAF's logic of readiness before deployment, participation of educators and learners, and accountable governance is not specific to Nigerian law. It may apply wherever institutions face comparable constraints, such as unstable power, large classes, and emerging data-protection regimes in other low- and middle-income contexts. Transfer would require adapting the governance layer to local law and regulators, recalibrating indicators to local baselines, and testing the framework across institutional types. Within Nigeria, it could be extended to universities under the NUC. Because SITAF has been derived from three cases and not yet tested elsewhere, scalability is a hypothesis for comparative research rather than a finding.

Conclusion

This paper has argued that AI-powered inclusive learning in Nigerian colleges of education and polytechnics depends less on technological novelty than on structural readiness. Three purposively selected cases; the Federal College of Education (Technical), Omoku; Kwara State Polytechnic, Ilorin; and the Federal School of Statistics has illustrated a pattern consistent with wider documented experience in Nigerian educational technology policy: technology deployed without infrastructure, adoption mandated without training, inclusion promised without governance, and reform launched without the maintenance mechanisms required to sustain it. Confirming how widely this pattern extends would require larger and more representative samples.

The contribution of this paper is SITAF, a four-layer maintenance mechanism with a five-stage roadmap that begins where Nigerian institutions actually are, with unstable electricity, overcrowded classrooms, undertrained staff, and fragmented digital tools, rather than assuming the resources of well-funded institutions. Its central claim is that sustainable inclusive adoption is achievable under these conditions when infrastructure stabilisation, leadership commitment, educator capacity building, controlled piloting, and institutional embedding are treated as sequential and interdependent requirements. The limits of the claim are real: leadership discontinuity may be the most likely cause of failure in practice, infrastructural dependency risks



indefinite deferral, and equity washing demands disaggregated measurement as a governance requirement. These limits locate responsibility with institutional, regulatory, and policy systems, not with lecturers mislabelled as resistant or students blamed for low digital literacy.

Two practical next steps follow. First, SITAF needs empirical validation through expert review, controlled pilots in two or three departments with baselines established for the proposed indicators and field-based or mixed-methods research that complements this documentary study. Second, it needs policy adoption: the NCCE should treat educational technology as a core teacher-training responsibility within digital inclusion policy, requiring practical digital pedagogy, inclusive technology training, and AI readiness across all departments, and the NCCE, NBTE, and NDPC should enforce minimum standards for infrastructure, accessibility, connectivity, staff training, and data protection consistently across administrations so that reforms do not disappear when leadership changes.

Nigeria cannot build inclusive AI-supported education if the institutions that train its teachers are themselves excluded from meaningful digital transformation. Inclusive AI adoption in Nigeria requires structural readiness, not just technological deployment.

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