International Journal of Quantitative and Qualitative Research Methods, 14(1),30-43, 2026
Print ISSN 2056-3620 (Print)
Online ISSN 2056-3639(Online)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development -UK

Examining Digital Inequality in the Artificial Intelligence Era through Information and Communication Technology Infrastructure Gaps in Nigerian Public University Libraries

Gilbert Paul Igboechesi
Librarian, University of Jos, Nigeria

Thomas Akinbayo Adigun
University Librarian, University of Uyo, Nigeria

doi: https://doi.org/10.37745/ijqqrm.13/vol14n13043 Published August 10, 2026

Citation: Igboechesi G.P. and Adigun T.A. (2026) Examining Digital Inequality in the Artificial Intelligence Era through Information and Communication Technology Infrastructure Gaps in Nigerian Public University Libraries, *International Journal of Quantitative and Qualitative Research Methods*, 14(1),30-43

Abstract: *The rapid diffusion of artificial intelligence (AI) into academic library services has widened the gap between libraries in high resource environments and those in the Global South. Nigerian public university libraries, serving an expanding higher education population, face a compounded set of barriers described in this paper as a triple threat: unreliable internet connectivity, chronic power instability, and costly foreign currency subscription models. This study adopted a mixed methods design involving ninety respondents drawn from ten public universities in North Central Nigeria, comprising ICT directors, university librarians, systems librarians, and digital resources officers. Data were analysed using descriptive statistics, a Weighted Average Index, and inferential tests. Findings show that bandwidth availability strongly predicts AI adoption readiness and that federal universities significantly outperform state universities on composite readiness scores. The offline AI powered reference chatbot emerged as the most desired application. The paper proposes a Frugal AI Framework built on offline language models, open-source systems, solar power, and localised African training data, and recommends targeted policy action by professional and funding bodies.*

Keywords: digital inequality, artificial intelligence, ICT infrastructure, Nigerian university libraries, frugal innovation, offline AI, Library

INTRODUCTION

Academic libraries across the world are being reshaped by the growing presence of artificial intelligence (AI) in reference services, cataloguing, and resource discovery. Institutions in North America, Western Europe, and parts of Asia now experiment with AI powered chatbots, predictive recommendation engines,

and automated metadata systems that were unimaginable a decade ago. Lund, Omame, Tijani, and Agbaji (2020) found that librarians in these advanced settings increasingly view AI as a normal extension of professional practice rather than a novelty. This growing normalisation reflects deep investment in bandwidth, electricity, and institutional funding that many libraries in the Global South simply do not share. In much of Africa, the promise of library artificial intelligence exists alongside infrastructural realities that make its adoption uneven and, in many cases, aspirational rather than operational. The contrast between these two worlds raises questions about whether the current model of AI in libraries can be meaningfully extended to institutions working under very different resource conditions. This tension forms the starting point of the present study, which turns attention to Nigerian public university libraries operating within the North Central geopolitical zone.

Nigerian public university libraries occupy a demanding position within this global picture, since they are expected to support research, teaching, and learning for a fast growing student population with comparatively modest technical resources. Many library staff members in the North Central zone continue to manage frequent internet slowdowns, unpredictable power outages, and subscription costs that rise sharply whenever the naira weakens against the dollar. These conditions are not isolated inconveniences; they recur with enough regularity to shape how librarians plan their daily service delivery. Systems/digital librarians often reschedule bandwidth heavy tasks to early morning hours, and some maintain informal backup arrangements to keep essential services running when the network fails. Such coping strategies reveal a professional community that is resourceful but structurally constrained, working to sustain service quality under conditions rarely discussed in mainstream library and information science (LIS) literature. Kayode, Tella, and Akande (2020) documented similar infrastructural strain in academic libraries in Kwara State, one of the states within the North Central zone, where cloud based service adoption was slowed by connectivity and cost barriers. Their findings, while focused on cloud computing rather than AI specifically, point to a longer standing pattern of infrastructural limitation that this paper extends into the AI era.

Much of the scholarly conversation on AI in academic libraries has been generated within and for institutions in the Global North, leaving the experiences of African libraries thinly represented in the disciplinary record. This imbalance is not simply a matter of representation, since it also shapes which problems the field considers worth studying and which solutions are treated as standard practice. When infrastructural constraint is treated as background noise rather than a central research variable, the resulting frameworks and tools tend to assume conditions of reliable power and abundant bandwidth that Nigerian libraries cannot take for granted. Practitioners in these settings are rarely absent from innovation; rather, their adaptive strategies are absent from the record that could make such innovation visible and transferable. The frugal engineering traditions that have produced mobile money platforms and low bandwidth communication tools across sub-Saharan Africa suggest that similar ingenuity could inform

library specific AI solutions. Recognising this potential requires a shift in framing, from treating Nigerian libraries as merely unready for AI to treating them as sites of distinctive problem solving under constraint.

The purpose of this study is to examine the state of ICT infrastructure in public university libraries within Nigeria's North Central geopolitical zone and to assess how that infrastructure shapes readiness for AI adoption. The study gives particular attention to internet bandwidth, power availability, and the cost structure of AI enabled tools and subscriptions, since these three conditions recur throughout practitioner accounts of library service delivery in the region. It also investigates the specific AI applications that library staff consider most useful, on the assumption that adoption strategies should be guided by expressed institutional need rather than by assumptions imported from better resourced settings. Whether bandwidth, power, and cost operate independently or interact to compound one another remains an open empirical question that this study is designed to address. The findings are expected to inform both institutional planning and the policy environment within which Nigerian academic libraries operate.

Problem Statement

Despite growing global enthusiasm for AI enabled library services, the specific conditions under which Nigerian public university libraries might adopt such services remain poorly documented. Existing Nigerian LIS studies have established that erratic power supply and limited bandwidth constrain digital service delivery broadly, yet few have examined how these constraints specifically shape readiness for AI adoption or which AI applications librarians themselves consider most valuable under such constraints. Idhalama, Oredo, and Makori (2025) confirmed persistent gaps in the availability and accessibility of digital resources across Nigerian public university libraries, but their study did not extend to AI specific readiness or to the interaction between bandwidth, power, and cost as compounding barriers. Without this more targeted evidence, policy bodies and university administrators risk designing AI investment strategies that assume infrastructural conditions Nigerian libraries do not possess, or, alternatively, risk excluding Nigerian libraries from AI planning altogether on the assumption that adoption is premature. It is not yet clear, from known existing literature, whether bandwidth, power availability, and subscription cost operate as independent barriers or as an interacting cluster that must be addressed together, nor is it clear which institutional funding type is better positioned to absorb the cost of AI adoption. This uncertainty leaves a gap between the ambitions of the modern Library and the operational reality of North Central Nigerian university libraries, a gap this study sets out to measure and describe. The problem, stated directly, is that the relationship between ICT infrastructure conditions and AI adoption readiness in Nigerian public university libraries has not been systematically examined by any known study, leaving both practitioners and policymakers without an empirical basis for planning.

Objectives of the Study

The general objective of this study was to examine how information and communication technology (ICT) infrastructure conditions shape artificial intelligence (AI) adoption readiness among public university libraries in Nigeria's North Central geopolitical zone.

Specifically, the study sought to:

1. Assess the current state of ICT infrastructure, including internet bandwidth, power availability, and hardware capacity, in public university libraries in North Central Nigeria.

2. Examine the relationship between internet bandwidth and AI adoption readiness among the sampled libraries.

3. Compare AI adoption readiness between federal and state university libraries in the zone.

4. Identify the AI applications that library staff consider most useful for their institutions.

5. Determine the barriers library staff perceive as most severe to AI adoption.

6. Propose a context appropriate Frugal AI Framework, and associated policy recommendations, for Nigerian public university libraries.

Research Hypotheses

This study tested two directional hypotheses.

1. H_1: There is a significant positive relationship between available internet bandwidth and AI adoption readiness scores among North Central Nigerian public university libraries.
2. H_2: Federal university libraries demonstrate significantly higher AI adoption readiness scores than state university libraries in North Central Nigeria.

Conceptual Clarification

Several terms recur throughout this paper and are clarified here below:

a) **Digital inequality** refers to the uneven distribution of access to, and effective use of, information and communication technology (ICT) across institutions and regions, extending beyond simple connectivity to include differences in speed, reliability, and affordability (Van Dijk, 2020).

b) **ICT infrastructure**, as used in this paper, denotes the combined physical and networked resources, including internet bandwidth, computing hardware, and electrical power, that enable a library to deliver digital services.

c) **AI readiness** describes the extent to which an institution possesses the technical, financial, and human capacity to adopt AI enabled tools into routine service delivery.

d) **Frugal innovation** refers to the deliberate design of solutions that are affordable, adaptable, and appropriate to resource constrained environments rather than imported unmodified from resource rich settings (Radjou & Prabhu, 2015).

e) **Offline or local AI** describes AI systems, particularly language models, that operate on local hardware without requiring a continuous internet connection, distinguishing them from cloud dependent AI platforms.

f) **Global North** refers, in this paper, to countries and institutions in North America, Western Europe, Australasia, and comparable high-income settings, where academic libraries typically operate with dependable electricity, high bandwidth connectivity, and hard currency purchasing power; it is used here mainly as a benchmark category against which infrastructural indicators are measured, illustrated in this paper by institutions such as MIT, Oxford, and the University of Toronto.

g) **Global South** refers to countries and institutions across Africa, Latin America, and much of Asia that share a broadly comparable position of infrastructural constraint and lower average income, a category within which Nigeria, and by extension the North Central Nigerian public university libraries examined in this study, sits; the term situates the present Nigerian case study within this wider comparative field without treating Nigeria as representative of every Global South setting.

h) **Frugal AI**, distinct from the broader concept of frugal innovation defined above, refers specifically to the four pillar framework this paper proposes, namely offline intelligence, open systems, green power, and localised knowledge, as a deliberate application of frugal innovation principles to artificial intelligence deployment in Nigerian academic libraries.

REVIEW OF RELATED LITERATURE

The concept of a fourth-generation library, often called Library 4.0, describes a model in which physical and digital library spaces merge into AI mediated information ecosystems capable of personalised recommendation, continuous cataloguing support, and always available reference assistance. Scholarly attention to this model has grown steadily, yet its empirical grounding remains concentrated in institutions with dependable electricity and broadband access. Lund, Omame, Tijani, and Agbaji (2020) surveyed academic library employees and found a generally favourable disposition toward AI adoption, with staff in more technically resourced roles expressing greater readiness than their peers in less resourced positions. Their study, though not focused on Africa, illustrates a pattern that recurs globally: perceived readiness tracks closely with prior exposure to functioning technical infrastructure. Where such exposure is limited, as in much of sub-Saharan Africa, the Library 4.0 vision risks becoming a description of what

some libraries already do rather than a genuinely global roadmap. This asymmetry is not incidental, since journal access costs, conference travel funding, and research grant mechanisms remain concentrated in institutions and regions that already enjoy stronger infrastructure. The result is a research literature that describes AI readiness primarily from the vantage point of libraries for whom bandwidth and power are not everyday constraints, leaving the experience of libraries like those in North Central Nigeria comparatively undertheorised.

Attention to unequal technology access is not new to information science and has long been discussed under the heading of the digital divide, a term used to describe uneven access to ICT across social, economic, and geographic lines. Early treatments of the concept framed it in binary terms, distinguishing simply between those who had internet access and those who did not (Norris, 2001). Subsequent scholarship has moved toward a more layered understanding, recognising that access itself varies in speed, stability, cost, and the range of activities it supports, a distinction often called the second level digital divide (Van Dijk, 2020). This layered view is particularly relevant to AI adoption in libraries, since the practical question for a Nigerian university library is rarely whether AI tools exist, but whether the available bandwidth, power, and budget make sustained use of those tools realistic. Cloud dependent AI platforms assume a baseline of connectivity and electrical reliability that many Nigerian academic libraries cannot guarantee across a working day. Kayode, Tella, and Akande (2020) observed that similar constraints slowed cloud computing adoption among academic libraries in Kwara State, citing bandwidth limitations and cost as recurring barriers to sustained use. Their findings, produced before the recent expansion of AI enabled library tools, nonetheless anticipate many of the constraints this paper investigates in more detail.

Where infrastructural limitation is treated as a fixed constraint rather than a temporary gap to be closed before meaningful technology adoption can begin, a different design logic becomes possible. Frugal innovation describes the deliberate development of solutions that are good enough, affordable enough, and appropriate enough for constrained environments, rather than scaled down versions of systems designed for resource rich settings (Radjou & Prabhu, 2015). This logic has already produced widely adopted African technologies, including mobile money platforms and low bandwidth communication tools, and there is no structural reason it could not extend to library AI. A related idea, which this paper terms slow AI by analogy with the slow food movement, favours periodic synchronisation and offline processing over continuous cloud dependent operation. A reference tool that answers routine student queries from a locally stored knowledge base, without requiring a live connection, can provide more dependable service in a power and bandwidth constrained library than a cloud-based system that fails whenever either resource is interrupted. This preference for reliability over immediacy reframes what counts as a successful AI deployment in the Nigerian context. The next paragraph considers the specific technical tools that make such offline deployment achievable at low cost.

The open-source AI landscape has expanded considerably in recent years, producing language models that can be compressed, or quantised, to run on ordinary computing hardware without cloud infrastructure. Meta's Llama model family and related architectures have been released under permissive licences and can operate on machines with as little as four to eight gigabytes of random-access memory once quantised (Touvron et al., 2023). Tools such as GPT4All, LocalAI, and Ollama provide accessible interfaces for deploying these models locally, reducing the technical expertise required to set up an offline reference assistant. Gerganov's (2023) llama.cpp implementation extends this accessibility further, allowing inference on hardware as modest as a single board computer, which makes offline AI plausible even for libraries operating on very limited budgets. Alongside these language model tools, open-source library management systems such as Koha provide a data infrastructure through which AI features, including automated subject suggestion and catalogue search assistance, can be layered without licence costs (Koha Community, 2024). Together, these developments indicate that the technical barrier to offline AI deployment has fallen considerably, even as the infrastructural and policy barriers documented in this paper persist. What remains largely unexamined in the literature is how Nigerian university libraries themselves perceive and prioritise these tools, a gap this study addresses directly.

RESEARCH METHODOLOGY

This study adopted a mixed methods research design, combining a quantitative structured questionnaire with qualitative semi-structured interviews to capture both measurable infrastructure indicators and the lived experience of library staff. A sequential explanatory model was followed, in which quantitative data were collected and analysed first, with qualitative data subsequently used to explain notable quantitative patterns. A mixed methods design was adopted because the research problem required both measurable infrastructure indicators, such as bandwidth and power hours, and contextual understanding of how library staff experience and manage those constraints. Sequential explanatory model was used, in which quantitative data were collected and analysed first, with qualitative interview data subsequently applied to explain notable patterns. This combination captured the scale of the infrastructure gap numerically while preserving the practical, day to day texture of professional experience that numbers alone cannot convey.

The study was delimited to public universities within Nigeria's North Central geopolitical zone, comprising the Federal Capital Territory and the states of Niger, Benue, Kogi, Nasarawa, Kwara, and Plateau. Ten public universities across this zone, comprising six federal and four state institutions, were purposively selected for their mix of urban and peri-urban locations. The target population comprised 90 (ninety) respondents, including ICT directors, university librarians, systems librarians or ICT officers, and digital or electronic resources officers drawn from each institution. A census approach was adopted rather than sampling, since the total eligible population within each institution was small enough for complete

enumeration to be practicable. All ninety questionnaires were returned and found usable, yielding a response rate of one hundred percent across the ten institutions.

Table 1. Distribution of Respondents by Institution

Institution	State	Type	Respondents
University of Abuja (UNIABUJA)	FCT	Federal	9
Joseph Sarwuan Tarka University, Makurdi	Benue	Federal	9
Federal University, Lafia (FULAFIA)	Nasarawa	Federal	9
Federal University of Technology, Minna	Niger	Federal	9
University of Jos (UNIJOS)	Plateau	Federal	9
Federal University, Lokoja	Kogi	Federal	9
Kogi State University, Anyigba	Kogi	State	9
Nasarawa State University, Keffi	Nasarawa	State	9
Ibrahim Badamasi Babangida University, Lapai	Niger	State	9
Plateau State University, Bokkos	Plateau	State	9
Total			90

Data were collected using a structured questionnaire covering institutional ICT infrastructure, current AI awareness and usage, perceived barriers to adoption, and desired AI applications, complemented by a semi-structured interview guide administered to a subset of respondents. Face validity was established through review by Librarians in the respective institutions, and a pilot test yielded a Cronbach's alpha of 0.87, indicating strong internal consistency. Quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including means and standard deviations, were computed for all infrastructure and barrier items. A Weighted Average Index (WAI) was calculated for each desired AI application, and Pearson's r together with an independent samples t-test were used to test the two study hypotheses at a significance level of $p < 0.05$. Qualitative interview data were analysed thematically following Braun and Clarke's (2006) six phase approach, with coding cross-checked by a second reader for consistency.

RESULTS AND DATA ANALYSIS

Table 2 compares key ICT infrastructure indicators for the sampled North Central Nigerian university libraries against documented Global North benchmarks, revealing substantial deficits across every measured dimension.

Table 2. ICT Infrastructure Indicators: North Central Nigeria Versus Global North Benchmarks

Indicator	North Central Nigeria	Global North Benchmark
Average bandwidth (Mbps, shared)	5.3	100+
Daily power availability (hours)	6.4	24
Libraries with functional UPS/generator	51%	100%
Libraries with a dedicated AI workstation	7%	-
Computer to student ratio (library terminals)	1:62	1:8
Staff with formal ICT/digital literacy training	28%	-
Budget allocated to digital resources	11.3%	35-50%

Source: Field Survey

The most acute deficit is in bandwidth, where a mean of 5.3 Mbps for a shared institutional library connection compares poorly with the 100 or more Mbps typical of Global North academic libraries, a disparity consistent with the wider Global South infrastructural pattern within which this Nigerian case study sits. Power availability of 6.4 hours per day, against a full day benchmark, compounds the problem, since only 51% of libraries possess a functional backup power system. The finding that only 7% of libraries possess a dedicated AI workstation, alongside a computer to student ratio of 1 to 62, illustrates a hardware deficit that would persist even if connectivity were improved. These three indicators, taken together, describe an environment in which cloud dependent AI tools are difficult to sustain regardless of staff willingness to adopt them.

Table 3 disaggregates bandwidth by institution type, showing a clear gradient between federally funded and state funded universities.

Table 3. Internet Bandwidth by Institution Type

Institution Type	Mean BW (Mbps)	Max	Min	SD
Federal universities	6.8	14.1	2.1	2.6
State universities	3.1	8.4	0.8	1.4
Overall mean	5.3	-	-	-

Note: BW = Bandwidth. SD = Standard Deviation.

Federal universities report a mean bandwidth more than double that of state universities, a gap that reflects the steadier federal funding streams described earlier in this paper. This differential, discussed further under hypothesis testing, offers one explanation for the composite AI readiness gap between the two institution types.

Table 4 presents the Weighted Average Index (WAI) for the six most desired AI applications, ranked by expressed staff interest on a five-point scale where 1 indicates very low priority and 5 indicates very high priority.

Table 4. Weighted Average Index of the Most Desired AI Applications

AI Application	WAI	Rank
Offline AI powered reference chatbot	4.54	1
Automated catalogue search and indexing	4.44	2
Digital resource recommendation engine	4.32	3
Offline plagiarism detection	4.27	4
AI assisted acquisition and collection development	4.17	5
Automated circulation and loan management	4.11	6

Note: All applications rated met or exceeded the 3.50 threshold defined as substantial interest.

The top four applications share a common feature: each addresses an immediate, high frequency operational task rather than a novel or experimental function. The primacy of the offline reference chatbot is particularly notable, since it suggests that staff are prioritising expanded service capacity within existing infrastructure constraints over more elaborate functionality, a finding that directly informs the Frugal AI Framework proposed later in this paper.

Table 5 reports mean severity ratings for the six most significant perceived barriers to AI adoption, assessed on a five-point Likert scale.

Table 5. Perceived Barriers to AI Adoption

Barrier	Mean	SD	Severity
Unreliable internet connectivity	4.71	0.52	Critical
Frequent power outages	4.68	0.61	Critical
High cost of hardware	4.55	0.71	Critical
Prohibitive subscription costs (USD)	4.49	0.74	Critical
Lack of trained IT support staff	4.32	0.84	High
Poor awareness of open-source alternatives	3.97	1.02	Moderate

The four most severe barriers, all rated above 4.40, correspond directly to the connectivity, power, and cost dimensions of the triple threat framework introduced earlier in this paper, and their low standard deviations indicate strong consensus rather than isolated complaint. Poor awareness of open-source alternatives, though only moderately severe, still points to a real capacity building need that complements the infrastructural findings.

Table 6 presents the results of hypothesis testing for the two study hypotheses.

Table 6. Summary of Hypothesis Testing

Hypothesis	Statistic	df	p-value	Decision
H_1: Bandwidth and AI readiness	r = 0.74	-	< .001	Supported
H_2: Federal vs. State readiness	t = 4.21	88	< .001	Supported

Both hypotheses were supported. H_1 shows that bandwidth availability is a strong predictor of AI adoption readiness, explaining a substantial share of the variance in readiness scores across the sample. This finding carries a direct practical implication: interventions that do not address bandwidth are likely to have limited impact regardless of other improvements made. H_2 confirms that federal universities significantly outperform state universities on composite AI readiness scores, a differential consistent with the funding gap documented in Table 3.

Qualitative interviews yielded three recurring themes that add texture to the quantitative findings. Survival mode management captures adaptive strategies such as scheduling bandwidth intensive tasks for early morning hours and maintaining manual backup systems during outages. Frustrated aspiration reflects a gap between staff members' clear sense of what AI could offer their users and their equally clear understanding of the barriers preventing it; one senior librarian summarised this by saying that the problem was not ignorance but infrastructure and funding. Energy as the master constraint emerged unprompted across interviews and positioned power instability as even more fundamental than bandwidth, since unreliable power makes every other technical investment unpredictable, reinforcing the quantitative picture with a firsthand practitioner perspective. Another librarian added that they had sometimes had to carry out their daily tasks using their personal mobile data subscriptions and personal laptops, because of inadequate ICT infrastructure.

DISCUSSION

The findings of this study confirm that ICT infrastructure conditions, rather than staff attitude or awareness alone, are the primary constraint on AI adoption readiness in North Central Nigerian public university libraries, and they illustrate, at institutional scale, the broader Global North and Global South asymmetry this paper set out from without treating Nigeria as a stand-in for every Global South setting. The strong positive relationship between bandwidth and readiness scores indicates that connectivity functions as a gatekeeping variable, one that limits the practical benefit of other interventions until it is addressed. Federal universities' significant advantage over state universities on composite readiness scores reflects the more consistent funding streams historically available to federally funded institutions, a pattern with direct implications for how funding bodies should target future investment. These results suggest that AI adoption in Nigerian academic libraries cannot be treated as primarily a training or awareness problem, since even highly motivated staff cannot sustain AI enabled services without adequate bandwidth and power. The qualitative findings reinforce this point, showing that library staff already understand their own constraints clearly and are waiting for infrastructural conditions rather than persuasion. This distinction between motivation and capacity is a central contribution of the present study to the wider literature on AI in academic libraries.

The Frugal AI Framework for Nigerian Academic Libraries

Drawing on the findings above and on the concepts of frugal innovation and slow AI introduced earlier, this paper proposes a Frugal AI Framework (FAF) organised around four pillars. The first pillar, offline intelligence, centres on deploying quantised, offline capable language models such as those enabled by GPT4All, LocalAI, Ollama, and llama.cpp on local institutional servers, providing the highest ranked desired service, an offline reference chatbot, without requiring continuous internet access. The second pillar, open systems, involves migrating from proprietary library management systems to open-source platforms such as Koha, which offers cataloguing, circulation, and reporting functionality at no licence cost and supports community developed AI assisted cataloguing modules. The third pillar, green power, addresses the power paradox directly through solar photovoltaic systems paired with battery storage, which can power a modest computing lab and a local AI server for a one-time capital cost that eliminates recurring diesel expenses. The fourth pillar, localised knowledge, calls for Nigerian libraries to contribute institutional repositories and catalogue metadata to shared African-centric training corpora, building on initiatives such as Masakhane's work on Nigerian languages, so that local AI tools serve Nigerian and African subject matter as well as they serve Western content. Each pillar responds to a specific dimension of the triple threat identified in the problem statement, and together they form a coherent, low-cost pathway to AI adoption that does not depend on prior grid-level infrastructural transformation.

Policy Recommendations

The Tertiary Education Trust Fund (TETFund) should lead a coordinated professional response to the infrastructure gap documented in this study by establishing a standing committee on AI and digital infrastructure to develop minimum ICT benchmarks and advocate for them with funding and regulatory bodies. A structured, short course certification programme in frugal AI deployment, covering tools such as GPT4All and LocalAI, would directly address the awareness gap identified among library staff. Partnerships with continental bodies such as the African Library and Information Associations and Institutions, alongside an annual research prize focused on low resource library AI, would further build local capacity and African centred scholarship.

The Tertiary Education Trust Fund (TETFund) holds the most direct financial leverage over library infrastructure investment and should create a dedicated funding category for solar powered ICT hubs, local AI server procurement, and last mile connectivity upgrades at qualifying campuses, with grant criteria that reward demonstrated renewable energy integration. New library construction and major renovation projects it funds should be required to incorporate minimum bandwidth allocation and solar backup provision from the outset, since retrofitting is considerably more costly than building these requirements in from the start.

The National Universities Commission (NUC) should revise its minimum academic standards for libraries to include specific ICT benchmarks, such as minimum bandwidth per student and evidence of an institutional AI policy, phased in gradually to reflect the baseline deficit documented in this study. It should also coordinate a Nation-wide academic library digital library consortium, modelled on its existing virtual library initiative, to pool licensing negotiations, shared data hosting, and technical support across member institutions, since costs prohibitive for individual libraries often become manageable when distributed.

The Universal Service Provision Fund (USPF) should prioritise tertiary education campuses in its connectivity project selection criteria, recognising that universities often serve as anchor points for internet access in surrounding communities as well as for their own staff and students. A targeted programme bringing last mile fibre connectivity to campuses currently below ten megabits per second, developed with the NUC and the Nigerian Tertiary Education Network (TENET), would directly address the bandwidth barrier this study found to be the strongest predictor of AI adoption readiness.

CONCLUSION

The Frugal AI Framework proposed in this paper offers one practical pathway through the constraints identified, built around offline language models, open-source systems, solar powered edge computing, and locally trained data resources, none of which require Nigerian libraries to wait for grid level transformation before beginning meaningful AI adoption. Library staff already know which AI applications would serve their users best, led by an offline reference chatbot that would not require constant connectivity. The infrastructure gap documented here is real and consequential, but it is not meant to be fixed, since frugal, offline, and solar powered alternatives already exist and are becoming more capable by the day. What remains is the institutional and policy commitment required to deploy them.

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