

## Financial and Infrastructure Constraints in Deploying AI for Business Education Research in Nigerian Tertiary Institutions

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Artificial Intelligence (AI) is redefining research production, pedagogical innovation, and institutional competitiveness in higher education globally. However, the diffusion of AI-driven systems within Nigerian tertiary institutions remains constrained by entrenched structural limitations. This study examines the financial, infrastructural, and governance-related factors inhibiting the effective deployment of AI in business education research across Nigerian universities. Specifically, it interrogates how underfunding, deficient digital infrastructure, unreliable electricity supply, limited technical capacity, and weak policy coordination shape institutional readiness for AI integration. A descriptive survey design was adopted, drawing on data from academic staff, ICT personnel, and postgraduate students across federal, state, and private tertiary institutions. Data were collected through a validated structured questionnaire and analyzed using descriptive statistical techniques. The findings reveal a strong consensus that high acquisition and maintenance costs of AI hardware and software, inadequate broadband connectivity, insufficient computing facilities, limited specialized training, and fragmented governance frameworks constitute significant barriers to sustainable AI adoption. These constraints collectively undermine research productivity, digital innovation capacity, and the global competitiveness of Nigerian business education. The study concludes that AI integration in Nigerian tertiary institutions requires systemic reform rather than incremental technological adoption. Dedicated funding mechanisms, strategic digital infrastructure investment, institutionalized AI governance frameworks, and sustained capacity-building initiatives are essential to reposition business education research within a digitally competitive knowledge economy. By situating the analysis within the Nigerian context, this study contributes to broader debates on AI diffusion, digital transformation, and innovation capacity in African higher education systems.

### **Background to the Study**

Artificial Intelligence (AI) is increasingly embedded within the epistemic and operational architecture of contemporary higher education systems. Beyond incremental technological enhancement, AI is redefining pedagogical design, research productivity, assessment regimes, and institutional governance through adaptive learning systems, predictive analytics, automated evaluation tools, and advanced data infrastructures. Within business education, these capabilities are particularly consequential. The discipline's reliance on quantitative modelling, decision analytics, forecasting, and simulation renders it structurally aligned with AI-enabled methodologies. Globally, AI-driven pedagogies and research ecosystems are reshaping how knowledge is generated, validated, and transferred across institutional and industry domains (UNESCO, 2023; Xu, 2024).

Despite this global acceleration, the diffusion and institutionalization of AI within Nigerian tertiary education remain uneven and structurally constrained. While awareness of AI's transformative potential has grown among faculty, students, and university administrators, institutional readiness has not progressed at a commensurate pace. Persistent fiscal limitations, infrastructural fragilities, and technical capacity gaps continue to delimit meaningful integration (Omorie, 2024; Eze & Amadi, 2024). In many business education departments, outdated computing infrastructure, unstable electricity supply, and unreliable broadband connectivity render sustained AI experimentation technically impracticable. These conditions inhibit not only pedagogical innovation but also the execution of computationally intensive research dependent on large datasets, cloud-based platforms, and high-performance processing environments (Obinna, 2024).

The institutional challenge extends beyond infrastructure to systemic alignment. National and institutional policy discourses increasingly advocate curriculum digitization, AI-enabled assessment systems, and data-driven research models. However, these aspirations are frequently decoupled from corresponding capital investment and capacity-building strategies (Okonkwo & Nwachukwu, 2023). The resulting implementation gap reflects a broader structural misalignment between technological ambition and resource allocation. In effect, AI integration remains rhetorically prioritized yet operationally under-resourced.

For business education, a field intrinsically oriented toward technological adoption, analytics, and innovation management; this structural lag has significant implications. Limited AI capacity constrains research sophistication, weakens industry relevance, and narrows graduate preparedness for digitally mediated labor markets. Moreover, constrained institutional capability reduces Nigeria's participation in global AI scholarship and diminishes the competitiveness of its knowledge economy (Adewale, 2024; Ogunleye, 2023; World Bank, 2024). The transformative potential of AI in Nigerian business education is therefore contingent rather than guaranteed. Its realization depends upon sustained investment in digital infrastructure, stable funding ecosystems,

advanced technical training, and coordinated governance frameworks. In contexts where these foundational conditions are underdeveloped, technological diffusion remains fragmented and experimental rather than systemic (Afolabi, 2023; Obinna, 2024). Consequently, Nigeria's higher education system stands at a critical inflection point: without deliberate structural reform, AI risks remaining a conceptual aspiration rather than an embedded driver of pedagogical and research transformation.

Figure 1.



Source: Authors Construct 2025

The integration of Artificial Intelligence (AI) into business education research in Nigerian tertiary institutions is shaped by a multilayered constraint environment operating across

national, institutional, and operational domains. At the macro level, public financing patterns constitute the structural foundation upon which technological innovation depends. Nigeria's public expenditure on education has consistently remained below the 15–20% benchmark recommended by UNESCO, with documented implications for research infrastructure, innovation output, and institutional competitiveness (UNESCO, 2022; World Bank, 2024). Within such a fiscal climate, investments in emerging technologies particularly capital-intensive AI systems—are often subordinated to recurrent expenditure priorities. The result is constrained acquisition of high-performance computing systems, advanced analytics platforms, research laboratories, and sustainable cloud-based resources essential for AI-driven inquiry.

At the institutional level, financial limitations intersect with infrastructural fragilities. Unreliable electricity supply, bandwidth instability, limited data storage capacity, and outdated digital equipment collectively undermine the operational continuity required for machine learning experimentation and large-scale data processing. These infrastructural deficits restrict methodological sophistication in business education research, where predictive modelling, simulation analytics, and algorithmic decision-support tools are increasingly central. Empirical observations suggest that AI adoption within Nigerian institutions therefore remains episodic and project-based rather than strategically institutionalized (Okonkwo & Nwachukwu, 2023). Human capital dynamics further compounds these structural weaknesses. The limited availability of advanced AI expertise within academia coupled with migration of skilled professionals to private industry and international markets constrains knowledge transfer, mentorship capacity, and interdisciplinary research collaboration. Without sustained faculty development pipelines and competitive research ecosystems, institutional AI initiatives struggle to achieve scalability or long-term sustainability (Afolabi, 2023; Omoregie, 2024).

Governance and coordination challenges reinforce these constraints. Fragmented policy frameworks, limited ethical standardization, and weak inter-agency alignment dilute strategic coherence in AI implementation (Abdullahi & Yusuf, 2023). In the absence of harmonized regulatory mechanisms and integrated funding models, resource allocation tends to be uneven, producing disparities between relatively well-resourced urban universities and underfunded state or rural institutions. This stratification deepens technological inequality and narrows the national innovation base.

Collectively, these macro-fiscal, infrastructural, human, and governance constraints generate systemic outcomes: fragmented AI integration, reliance on externally funded initiatives, uneven institutional readiness, and reduced global research visibility. As noted in recent national and international assessments (FMCIDE, 2024; World Bank, 2024), sustained transformation requires coordinated public investment, institutional capacity strengthening, targeted skills development, and regulatory harmonization. Absent such systemic reform, the transformative potential of AI in Nigerian business education research will remain structurally constrained rather than strategically realized.

### **Infrastructure Deficits: Power, Facilities, and Equipment**

Infrastructural deficits further exacerbate these funding limitations. Reliable electricity supply remains one of the most critical bottlenecks to AI deployment in Nigerian universities. Frequent power outages, voltage instability, and dependence on costly alternative energy sources disrupt computationally intensive research activities that require uninterrupted processing cycles (Ogunleye, 2023). The absence of purpose-built facilities such as climate-controlled server rooms, advanced cooling systems, and uninterruptible power supply (UPS) infrastructure raises maintenance costs and accelerates hardware degradation, thereby undermining the operational viability of AI research environments (Eze & Amadi, 2024). These infrastructural weaknesses reduce institutional willingness to commit scarce resources to AI investments perceived as high-risk.

### **Connectivity Challenges and Cloud Dependence**

Connectivity challenges and cloud dependence introduce an additional layer of complexity. Although broadband penetration in Nigeria has improved, internet reliability, bandwidth consistency, and data latency remain inadequate for large-scale, data-intensive AI research (Nigerian Communications Commission [NCC], 2024). Business education researchers are often compelled to rely on cloud-based platforms for data storage and model deployment; however, recurring subscription fees denominated in foreign currency expose institutions to exchange-rate volatility and escalating costs (Adewale, 2024). This creates a structural dilemma between investing in expensive local infrastructure or depending on unstable and financially burdensome cloud services both options stretching already limited institutional budgets.

### **Hardware, Software Costs, and Sustainability Concerns**

The sustainability of AI initiatives is further threatened by the high cost of hardware and software acquisition. AI research demands continuous upgrades of computing equipment, licensed analytical tools, and secure data storage systems. Yet, many Nigerian universities operate with obsolete ICT infrastructure due to erratic funding flows and weak maintenance cultures (Abdullahi & Yusuf, 2023). Without ring-fenced funding mechanisms or multi-year investment plans, AI-driven business education research risks remaining ad hoc, donor-dependent, and unsustainable in the long term.

### **Human Capital and Skills Development**

Human capital constraints represent another critical dimension of the problem. While awareness of AI applications in education and research is increasing, practical expertise among academic staff remains limited (Omorie, 2024). Highly skilled AI researchers and data scientists are often attracted to better-remunerated opportunities in the private sector or abroad, intensifying brain drain and widening institutional capability gaps (Okafor, 2023). This shortage of qualified personnel not only constrains research output but also weakens mentoring pipelines necessary for building indigenous AI capacity within business education departments.

### **Institutional Governance and Policy Alignment**

Institutional governance and policy misalignment further limit progress. Many Nigerian universities lack comprehensive frameworks governing AI procurement, ethical data use, intellectual property protection, and interdisciplinary collaboration (Ikechukwu & Nwosu, 2024). At the national level, inconsistencies among regulatory agencies particularly the National Universities Commission (NUC) and the Tertiary Education Trust Fund (TETFund) have resulted in fragmented funding priorities and limited coordination of AI-related initiatives (TETFund, 2024). This policy incoherence reduces economies of scale and weakens strategic planning for AI integration across the higher education system.

### **Equity and the Emerging Digital Divide**

Equity considerations also warrant attention. The uneven distribution of financial and infrastructural resources across Nigerian tertiary institutions has deepened the digital divide. Federal and well-endowed private universities, often located in urban centres, are more likely to access grants and partnerships, while state-owned and rural institutions remain marginalised (Ogunjobi, 2023). This disparity threatens the inclusivity of AI-driven business education research and risks producing a two-tier academic system with uneven research and graduate outcomes.

### **Positive Developments and Strategic Opportunities**

Despite these challenges, emerging opportunities signal potential pathways forward. Recent policy initiatives by the Federal Ministry of Communications, Innovation, and Digital Economy (FMCIDE, 2024), alongside growing private-sector interest, indicate a nascent commitment to AI capacity development. International collaborations, donor-funded projects, and regional innovation ecosystems offer strategic entry points for shared infrastructure, pooled procurement, faculty exchange, and the establishment of regional AI research hubs (World Economic Forum, 2024). Harnessing these opportunities through coordinated funding, governance reforms, and capacity-building strategies could reposition Nigerian business education research within the global AI landscape.

### **Synthesis and Implications for Business Education Research**

Taken together, financial and infrastructure constraints shape not only the feasibility but also the direction of AI-driven research in business education. Where funding is limited, studies tend to remain theoretical rather than experimental, often relying on secondary data. Yet, in a rapidly digitizing global economy, practical AI applications such as predictive analytics, business simulations, and decision modeling are essential for producing industry-ready graduates. Addressing these systemic limitations therefore requires coordinated investments in digital infrastructure, faculty capacity development, and institutional reforms to align Nigeria's business education research with global AI standards (Afolabi, 2023; Obinna, 2024).

Despite the growing global discourse on Artificial Intelligence (AI) in education, empirical studies focusing on financial and infrastructural barriers to AI deployment in business education research within Nigerian tertiary institutions remain limited. Most available literature emphasizes AI's pedagogical potential or ethical implications (Afolabi, 2023; UNESCO, 2024) but provides minimal insight into the institutional resource dynamics that underpin successful AI integration. Furthermore, existing studies often treat “funding” and “infrastructure” as isolated variables rather than interrelated systemic challenges affecting research capacity and innovation culture (Babalola & Daramola, 2023). There is also a lack of data-driven assessments across different institutional types (federal, state, and private universities), which restricts the understanding of context-specific barriers and comparative readiness levels. This study bridges these gaps by providing empirical evidence from multiple Nigerian tertiary institutions, analyzing the interplay between financial limitations, infrastructural deficiencies, and AI-driven research adoption. By situating these issues within the broader context of digital transformation and educational policy reform, the study contributes to a more integrated and actionable framework for advancing AI-based research in business education.

### **Statement of the Problem**

Artificial Intelligence (AI) has emerged as a transformative force in business education research, offering significant potential to enhance data analytics, decision modelling, forecasting, and pedagogical innovation. Globally, higher education institutions are increasingly integrating AI-driven tools to improve research efficiency, methodological rigor, and knowledge production. However, within the Nigerian higher education context, particularly in business education, the deployment of AI remains uneven and largely underdeveloped. Despite growing scholarly and policy-level recognition of AI's strategic importance, Nigerian tertiary institutions continue to face persistent financial and infrastructural constraints that undermine effective AI adoption in business education research. Chronic underfunding of the education sector has limited institutions' capacity to invest in essential AI infrastructure, including high-performance computing systems, reliable cloud services, licensed software, and continuous professional development for academic staff (UNESCO, 2022; TETFund, 2024). As a result, AI-related research initiatives are often sporadic, dependent on short-term donor funding, and lacking long-term sustainability. Infrastructural deficits further compound these challenges. Unstable electricity supply, inadequate broadband connectivity, obsolete data management systems, and weak maintenance cultures significantly constrain the operationalisation of AI technologies in research environments (Ogunjobi, 2023; NCC, 2024). Even in institutions where digital facilities exist, limited technical support and insufficiently trained personnel frequently render such infrastructure underutilised. The scarcity of AI-competent educators and researchers restricts knowledge transfer, slows institutional learning, and reinforces dependence on external expertise (Okafor, 2023; Omoregie, 2024). Beyond resource limitations, the absence of coherent institutional and national governance frameworks for AI integration represents a critical structural weakness. There is currently no coordinated national strategy

guiding AI deployment in academic research, including standards for data governance, ethical use, capacity development, and inter-institutional collaboration (Ikechukwu & Nwosu, 2024). This policy vacuum has resulted in fragmented implementation, duplication of efforts, and inefficient utilisation of scarce resources across Nigerian universities.

While existing literature has extensively discussed the theoretical potential and pedagogical implications of AI in higher education, there is a notable paucity of empirical and context-specific studies that systematically examine the combined financial, infrastructural, and governance constraints affecting AI deployment in business education research within Nigerian tertiary institutions. In particular, limited attention has been given to how these constraints interact to shape institutional readiness, research productivity, and sustainable AI adoption. This gap constrains evidence-based policymaking and hinders the development of scalable models for AI integration in Nigerian business education research. Accordingly, this study seeks to critically interrogate the extent, nature, and interrelationships of financial and infrastructural challenges constraining AI deployment in business education research across Nigerian tertiary institutions, with the aim of informing policy, institutional planning, and sustainable implementation strategies.

### **Research Objectives**

The overarching aim of this study is to examine the contemporary financial and infrastructural constraints affecting the deployment of Artificial Intelligence (AI) in business education research within Nigerian tertiary institutions. Specifically, this research seeks to:

1. Identify the major financial limitations hindering the integration of AI technologies in business education research.
2. Examine the infrastructural deficiencies including power, internet connectivity, and equipment that affect AI deployment in Nigerian universities.
3. Assess the impact of these constraints on the quality, scope, and sustainability of business education research.
4. Explore institutional, policy, and capacity-related factors contributing to these challenges.

### **Research Questions**

To achieve the stated objectives, the study is guided by the following research questions:

1. What are the key financial constraints affecting the deployment of AI for business education research in Nigerian tertiary institutions?
2. What infrastructural challenges such as power, connectivity, and hardware – limit effective AI integration?
3. How do these financial and infrastructural challenges influence the effectiveness and quality of business education research?
4. What institutional and policy factors exacerbate or mitigate these challenges?

## **Theoretical Framework**

This study is anchored on two interrelated theories: The Technology–Organization–Environment (TOE) Framework and the Resource-Based View (RBV) which together provide a comprehensive lens for understanding how financial and infrastructural constraints influence AI adoption in business education research.

### **i. Technology–Organization–Environment (TOE) Framework**

The TOE Framework, first developed by Tornatzky and Fleischer (1990), explains the factors influencing technology adoption within institutions. It posits that three contextual elements, technological capability, organizational readiness, and environmental factors collectively determine the success or failure of new technology implementation. In the context of this study, the technological dimension represents the availability of AI tools, computing power, and digital infrastructure; the organizational dimension encompasses internal structures, human capital, and funding mechanisms; while the environmental dimension reflects regulatory policies, external funding, and socio-economic conditions (Abubakar & Musa, 2023; Xu, 2024). Applying the TOE framework to Nigerian tertiary institutions helps explain why even when awareness of AI is high, adoption remains low. Many institutions lack not only the necessary infrastructure but also the organizational capacity and external support to sustain innovation. Hence, the TOE model offers a practical guide for diagnosing adoption readiness and identifying intervention points.

### **ii. Resource-Based View (RBV)**

Complementing the TOE framework, the Resource-Based View (Barney, 1991) emphasizes that an organization's competitive advantage depends on the unique resources it possesses—whether physical, human, financial, or technological. From this perspective, the deployment of AI in business education research can only be effective when institutions possess or can develop valuable, rare, inimitable, and non-substitutable (VRIN) resources (Grant, 2019).

In Nigerian tertiary institutions, financial resources, infrastructure, and digital competencies represent strategic assets necessary for AI research. However, persistent funding shortfalls, brain drain, and infrastructural deficits weaken these capabilities (Afolabi, 2023; Abdullahi & Yusuf, 2023). The RBV thus underscores the need for universities to strategically invest in resource accumulation and capability development as preconditions for successful AI adoption.

## **Integrative Rationale**

By combining the TOE and RBV frameworks, this study adopts a multidimensional approach: the TOE model highlights contextual readiness factors, while the RBV emphasizes resource possession and strategic utilization. Together, they provide a holistic understanding of how financial and infrastructural limitations intersect with organizational and environmental factors to shape AI adoption outcomes in business education research (Obinna, 2024; Omoregie, 2024). This integrative perspective not only

informs the study's analytical framework but also provides a theoretical foundation for designing sustainable solutions that address both structural and strategic dimensions of AI deployment in Nigerian tertiary institutions.

### **Methodology**

The study adopted a pragmatic research paradigm, integrating quantitative and qualitative approaches to examine financial and infrastructural constraints affecting AI deployment in business education research across Nigerian tertiary institutions. A descriptive survey design was employed to capture current perceptions, institutional realities, and patterns of relationships among relevant variables, allowing comparative analysis across tertiary institutions in Nigeria. The target population comprised 2,000 academic staff, ICT personnel, and students from business education selected for their direct involvement in teaching, research, and ICT management. A sample of 420 respondents was drawn using a multi-stage sampling technique: stratified sampling to categorize tertiary institutions by type, purposive sampling to select six tertiary institutions with notable ICT infrastructure and technology initiatives, and simple random sampling to choose respondents within each institution, ensuring representativeness and minimizing bias. Data were collected using a structured questionnaire titled AI Deployment and Infrastructure Constraints in Business Education Research (AIDIC-BER), covering financial constraints, infrastructural challenges, institutional readiness, and perceived research impact. The instrument included 35 items in an open-ended question to capture qualitative insights. Questionnaires were administered online (via Google Forms) with ethical clearance obtained and participants informed about confidentiality and voluntary participation. Data collection spanned eight weeks to accommodate academic schedules. Quantitative data were analyzed using descriptive statistics in SPSS 26, while qualitative responses were subjected to thematic analysis following Braun and Clarke (2019).

### **Ethical Considerations**

Ethical principles of voluntary participation, confidentiality, and informed consent guided this study. Respondents' identities were anonymized, and data were used solely for academic purposes. All research activities complied with the Nigerian National Code of Health Research Ethics (NHREC, 2023) and institutional data protection standards.

### **Results**

The results of this study are presented in line with the research objectives and analyzed using descriptive statistics (mean and standard deviation). The interpretation is based on the benchmark of 3.00 as the criterion mean.

**Table 1:** Key Financial Constraints Affecting AI Deployment in Business Education Research

Item	Mean	SD	Interpretation
Insufficient R&D funding for AI projects	4.52	0.61	Strongly agreed: Most respondents perceive lack of dedicated research funding as a major barrier.
High cost of AI hardware and cloud services	4.47	0.68	Strongly agreed: Acquisition and subscription costs limit AI adoption.
Dependence on short-term donor funding	4.35	0.71	Agreed: Reliance on unsustainable external funding constrains long-term AI programs.
Lack of budgetary allocation for AI training	4.28	0.75	Agreed: Insufficient investment in human capacity development affects research quality.

**Interpretation:**

The data indicates that financial constraints are a critical limiting factor in deploying AI. The high costs of equipment, limited internal funding, and dependence on short-term grants undermine sustainability, inhibit innovation, and reduce institutional readiness for AI-based business education research.

**Table 2:** Infrastructural Challenges Limiting AI Integration

Item	Mean	SD	Interpretation
Unreliable electricity supply	4.58	0.54	Strongly agreed: Frequent power outages disrupt AI research and teaching activities.
Poor broadband internet connectivity	4.45	0.67	Strongly agreed: Internet limitations affect cloud-based AI tools and data sharing.
Obsolete ICT facilities	4.33	0.72	Agreed: Lack of modern computing infrastructure hinders AI experimentation and analysis.
Lack of data centers and server rooms	4.21	0.78	Agreed: Institutions are unable to host AI software and datasets locally.

**Interpretation:**

Infrastructural deficits create operational bottlenecks that limit AI adoption. Without reliable power, robust internet, and updated facilities, AI tools remain underutilized, research productivity is constrained, and institutions fail to develop sustainable digital capabilities.

**Table 3:** Influence of Financial and Infrastructural Challenges on Business Education Research

Item	Mean	SD	Interpretation
Fragmented adoption of AI in research	4.40	0.64	Agreed: AI deployment is uneven across departments and institutions.
Reduced research productivity	4.50	0.59	Strongly agreed: Constraints slow data analysis, experimentation, and publication output.
Reliance on donor-funded projects	4.32	0.70	Agreed: Research continuity suffers due to temporary project-based support.
Widening digital divide among institutions	4.28	0.74	Agreed: Urban/privileged institutions outperform rural and state institutions.

**Interpretation:**

Financial and infrastructural constraints negatively impact the quality, scope, and sustainability of business education research. AI-dependent research is fragmented, and productivity gaps widen between well-resourced and under-resourced institutions, reducing overall competitiveness in global academic and industry networks.

**Table 4:** Institutional and Policy Factors Exacerbating or Mitigating Challenges

Item	Mean	SD	Interpretation
Lack of institutional AI policies	4.35	0.68	Agreed: Absence of clear AI guidelines reduces coordinated adoption.
Weak inter-agency coordination (NUC, TETFund, Ministries)	4.41	0.63	Strongly agreed: Fragmented governance hinders coherent implementation strategies.
Absence of AI ethics framework	4.22	0.71	Agreed: Unclear ethical policies discourage experimentation and collaboration.
Emerging government and donor initiatives	3.87	0.82	Moderately agreed: Programs exist but are insufficiently scaled or harmonized.

**Interpretation:**

Institutional and policy factors amplify financial and infrastructural constraints. Without coordinated frameworks, clear ethics guidelines, and harmonized funding mechanisms, AI deployment remains piecemeal. While there are early-stage government and donor interventions, they are insufficient to fully mitigate systemic limitations in Nigerian tertiary institutions.

**Table 5:** Summary of Mean and Standard Deviation of Respondents on Financial and Infrastructural Constraints Affecting AI Deployment in Business Education Research

S/N	Item Description	Mean (M)	SD	Interpretation
1	Inadequate funding for AI infrastructure acquisition in tertiary institutions limits research output.	4.52	0.81	Strongly Agree
2	Irregular budgetary allocations and poor financial prioritization hinder AI integration in business education.	4.47	0.85	Strongly Agree
3	High cost of AI software licensing and maintenance reduces research participation.	4.33	0.88	Agree
4	Limited digital infrastructure such as broadband internet and power supply affects AI utilization.	4.60	0.79	Strongly Agree
5	Outdated computer laboratories and low server capacity impede AI data processing.	4.29	0.90	Agree
6	Absence of institutional AI research funding and grant opportunities weakens motivation.	4.41	0.83	Strongly Agree
7	Inadequate technical support and poor ICT management systems constrain AI experimentation.	4.38	0.87	Agree
8	Weak partnerships with tech companies affect knowledge transfer and AI innovation.	4.24	0.92	Agree
9	Poor maintenance culture and bureaucratic delays in resource approval discourage AI research continuity.	4.35	0.86	Agree
10	Lack of digital research repositories and data-sharing frameworks limits collaboration.	4.30	0.88	Agree

**Source:** Grand Mean = 4.39, SD = 0.86 (Strong Agreement)

### Interpretation of Results

The findings reveal a high level of agreement among respondents that financial and infrastructural constraints significantly impede the deployment of AI in business education research within Nigerian tertiary institutions. With a grand mean score of 4.39, respondents strongly agreed that issues such as inadequate funding, poor infrastructure, and lack of institutional support are major barriers. Specifically, limited broadband access (M = 4.60) and inadequate funding (M = 4.52) were rated as the most critical constraints, indicating that AI implementation remains primarily challenged by technological and economic deficits. The standard deviation values (ranging from 0.79–0.92) suggest moderate homogeneity in responses, implying consistent perceptions across federal, state, and private universities.

### Discussion of Findings

The study examined financial, infrastructural, institutional, and policy constraints affecting the deployment of Artificial Intelligence (AI) in business education research across Nigerian tertiary institutions. The findings indicate that financial limitations are

the most significant barriers to AI adoption. Specifically, insufficient R&D funding, high costs of AI hardware and cloud services, and dependence on short-term donor support impede sustainable integration. This finding aligns with UNESCO (2022) and Abdullahi and Yusuf (2023), who note that chronic underfunding in Nigerian higher education limits access to advanced technologies and reduces research innovation. Okonkwo and Nwachukwu (2023) further argue that inadequate institutional funding undermines strategic investments in both AI infrastructure and human capacity, reinforcing the study's results.

Infrastructural challenges, particularly unreliable electricity, poor broadband connectivity, and obsolete ICT facilities, emerged as critical impediments. Frequent power outages and low-speed internet disrupt data-intensive AI applications, while outdated hardware hampers experimentation and teaching (Ogunleye, 2023; Eze & Amadi, 2024). These findings resonate with Omoregie (2024), who emphasizes that digital infrastructure gaps in Nigerian universities constrain AI-enabled learning and research. The observed infrastructural deficiencies also exacerbate inequities among institutions, with urban universities having a disproportionate advantage over rural and state-owned institutions, reflecting a widening digital divide (Ogunjobi, 2023).

The study further revealed that institutional and policy factors significantly influence AI adoption. Weak inter-agency coordination among the NUC, TETFund, and relevant ministries, coupled with the absence of AI ethics frameworks and fragmented governance, reduces institutional readiness and coherence. Ikechukwu and Nwosu (2024) highlight that fragmented governance leads to duplication of efforts, inefficiency, and underutilization of scarce resources, corroborating these findings. Notably, while emerging government and donor programs provide some relief, they remain insufficient to address the systemic challenges.

Finally, the interplay of these financial, infrastructural, and governance constraints translates into operational and systemic outcomes such as fragmented AI adoption, low research productivity, donor dependency, and reduced global competitiveness. This observation aligns with UNESCO (2022) and World Economic Forum (2024), which argue that sustainable AI integration requires holistic strategies encompassing funding, infrastructure, human capital, and governance reforms.

In summary, the findings underscore that AI deployment in Nigerian business education research is constrained by multi-level systemic factors. Addressing these challenges requires coordinated policy interventions, strategic investment in infrastructure and human capacity, and institution-specific frameworks to enable sustainable AI integration and improve research quality. The study's findings also align with earlier studies emphasizing that AI integration in African higher education is largely constrained by financial and infrastructural inadequacies (Afolabi, 2023; Chiemeké & Osagie, 2024). The high mean scores observed across all items reinforce the reality that despite policy enthusiasm for digital transformation, budgetary constraints, unstable power supply, and limited technical infrastructure remain unresolved bottlenecks.

The result corroborates Adeleke and Sulaiman (2023) who argued that universities in Nigeria still struggle with obsolete ICT infrastructure and inconsistent funding frameworks, thereby limiting the operationalization of emerging technologies like AI. Similarly, Kumar and Eze (2022) found that sustainable digital research systems require both financial stability and human capacity development, which are often lacking in public universities. Moreover, the observed weak institutional-industry partnerships ( $M = 4.24$ ) reflect a broader pattern of isolation in academic innovation. Without active collaboration with private technology firms, universities cannot adequately access advanced AI tools, software, or mentorship programs necessary for transformative research (Nwosu, 2024).

The findings further emphasize the interdependence of financial capacity and digital infrastructure. The significant overlap between funding inadequacies and infrastructural decay highlights what Babalola and Daramola (2023) termed the “vicious cycle of underfunding and digital stagnation”, where inadequate funding perpetuates obsolete facilities and reduced research competitiveness.

In summary, the study reveals that the lack of sustainable financing mechanisms, infrastructural upgrades, and policy support systems continues to hinder AI-driven research innovation in business education across Nigerian tertiary institutions.

### **Policy and Institutional Reform Pathways for AI-Driven Research in Nigerian Higher Education**

The implications of these findings extend beyond diagnostic observation to strategic intervention. For educational policymakers, institutional leaders, and development partners, the central challenge is not whether Artificial Intelligence (AI) should be integrated into Nigerian higher education, but how structural conditions can be recalibrated to enable sustainable, system-wide adoption. Addressing the financial, infrastructural, and human capital constraints identified earlier requires coordinated reforms operating at fiscal, institutional, and ecosystem levels.

**Strategic Funding Reform:** Sustainable AI integration necessitates predictable and ring-fenced financing mechanisms. The Federal Government, particularly through the Tertiary Education Trust Fund (TETFund), could institutionalize a dedicated Artificial Intelligence Research and Infrastructure Grant (AIRIG) framework to support high-performance computing acquisition, AI laboratories, licensed software access, and long-term research clusters. Such targeted funding would reduce reliance on fragmented, donor-driven initiatives and create continuity in AI-based research development. By embedding AI within structured capital expenditure planning, institutions can transition from experimental pilots to institutionalized research ecosystems.

**Digital Infrastructure Modernization.:** AI-enabled research and pedagogical innovation are contingent upon stable and scalable digital infrastructure. Universities must prioritize broadband expansion, resilient power supply systems, secure data

storage architectures, and modern computing facilities to ensure uninterrupted experimentation and collaborative research environments (Olaoye & Adegbile, 2023). Infrastructure investment should be conceptualized not as ancillary support but as core academic capital essential for computationally intensive inquiry and advanced analytics in business education.

**Public-Private Innovation Ecosystems:** The development of AI capacity within universities is unlikely to be achieved through public financing alone. Structured public-private partnerships (PPP) can catalyze knowledge exchange, technology transfer, and resource pooling. Strategic collaboration with global technology firms such as Google and Microsoft, alongside indigenous AI startups, can provide access to research platforms, cloud computing credits, faculty training, and student internship pipelines (UNESCO, 2024). Such ecosystem-based partnerships reposition universities as active nodes within national and global innovation networks rather than isolated academic entities.

**Capacity Building and Policy Coherence:** Human capital development remains a foundational determinant of AI sustainability. Institutionalized professional development programs for academic staff, researchers, and ICT personnel are required to strengthen algorithmic literacy, data governance competencies, and interdisciplinary collaboration. Importantly, institutional AI strategies should be aligned with Nigeria's National Digital Economy Policy and Strategy (NDEPS 2023–2030) to ensure coherence between higher education transformation and broader national innovation objectives. Policy alignment mitigates fragmentation and enhances resource optimization across ministries and regulatory agencies.

**Institutional Governance and Research Architecture:** At the university level, the establishment of AI research units or innovation hubs with clearly defined governance frameworks, accountability mechanisms, and open-data policies can provide organizational stability for interdisciplinary scholarship. Embedding AI within formal research structures enhances transparency, promotes ethical oversight, and facilitates sustained collaboration across business education, computer science, and policy studies. Collectively, these reform pathways underscore that AI-driven transformation in Nigerian tertiary education is a systemic undertaking rather than a technological upgrade. Realizing its potential requires integrated investment across fiscal policy, infrastructure modernization, institutional governance, and human capital development. Without such coordinated reform, AI adoption will remain fragmented and episodic; with it, Nigerian universities can reposition themselves as credible contributors to global AI scholarship and innovation.

## **Conclusion**

This study critically interrogated the financial and infrastructural determinants constraining the deployment of Artificial Intelligence (AI) in business education research across Nigerian tertiary institutions. The empirical evidence demonstrates a pronounced

convergence of perceptions among academic staff, ICT professionals, and postgraduate students that structural underfunding, deficient digital infrastructure, unstable electricity supply, and weak institutional policy frameworks constitute the principal barriers to meaningful AI integration. The consistently high mean ratings on funding- and infrastructure-related indicators signal not episodic challenges, but entrenched systemic deficiencies that impede technological modernization and research competitiveness.

Importantly, the findings reveal that these obstacles extend beyond technical limitations. They are embedded within broader governance and policy environments characterized by irregular budgetary commitments, administrative fragmentation, limited strategic coordination, and insufficient academia-industry collaboration. In this regard, AI adoption in Nigerian business education cannot be conceptualized as a discrete technological upgrade; rather, it represents a structural transformation requiring fiscal realignment, infrastructural regeneration, and institutional reform. From a macro-development perspective, delayed or fragmented AI integration carries significant implications. In an era in which advanced analytics, predictive modelling, and algorithmic decision systems increasingly define scholarly productivity and graduate employability, sustained institutional lag risks widening the technological and research performance gap between Nigerian universities and those operating within digitally mature ecosystems. Such divergence undermines global competitiveness, knowledge production capacity, and the strategic positioning of Nigeria within the emerging digital economy. Accordingly, this study concludes that the future trajectory of business education research in Nigeria hinges on coordinated and sustained investment in AI-enabled infrastructure, deliberate leadership commitment, and policy frameworks that embed innovation within national development priorities. Absent systemic reform, AI will remain aspirational rhetoric; with it, Nigerian tertiary institutions can transition toward technologically resilient, research-intensive, and globally connected academic environments.

### **Recommendations**

Grounded in the empirical findings and analytical conclusions of this study, the following recommendations are advanced to inform strategic action among policymakers, university leadership, and development stakeholders. These recommendations are framed not as isolated interventions, but as mutually reinforcing components of a systemic reform agenda for AI-enabled business education research in Nigeria.

1. **Institutionalize Dedicated AI Research Financing Mechanisms:** Sustainable AI deployment requires predictable, ring-fenced capital investment. The Federal Government and tertiary education funding agencies—particularly the Tertiary Education Trust Fund (TETFund)—should establish dedicated budgetary lines for AI research infrastructure, including high-performance computing systems, cloud-based research environments, advanced analytics software, and interdisciplinary AI

laboratories. Embedding such allocations within medium- to long-term expenditure frameworks would mitigate reliance on ad hoc or donor-dependent initiatives and strengthen institutional planning capacity.

2. **Prioritize Digital Infrastructure Modernization:** AI-driven research is contingent upon resilient digital ecosystems. Universities should work in structured collaboration with the Federal Ministry of Communications, Innovation and Digital Economy to expand high-speed broadband connectivity, modernize computing laboratories, deploy secure data storage architectures, and ensure stable electricity supply. Infrastructure renewal should be treated as foundational academic capital rather than ancillary technical support, given its centrality to computational modelling, machine learning experimentation, and large-scale data analytics.

3. **Develop Structured Public-Private Innovation Partnerships.:** Given fiscal constraints within public institutions, structured public-private partnerships (PPP) are essential to accelerate AI capability development. Universities should formalize collaboration frameworks with technology firms, AI startups, and international research organizations to access cloud computing credits, research grants, technical training, and innovation incubation platforms. Such partnerships should move beyond episodic sponsorship arrangements toward long-term ecosystem integration that fosters knowledge transfer and applied research commercialization.

4. **Institutionalize Comprehensive Capacity Development Programs:** Human capital remains the critical enabler of technological transformation. Universities should embed continuous professional development programs focused on AI literacy, advanced data analytics, machine learning methodologies, research ethics, and data governance. Targeted training for academic staff, ICT professionals, and postgraduate researchers will enhance methodological sophistication and reduce dependency on external technical expertise. Capacity-building initiatives should be performance-linked and integrated into institutional research strategies.

5. **Establish Robust AI Governance Frameworks:** To ensure sustainable and ethically responsible AI adoption, universities must develop internal governance architectures that define ethical standards, funding procedures, data-sharing protocols, cybersecurity safeguards, and interdisciplinary coordination mechanisms. The establishment of AI research units or innovation hubs with clear accountability structures can enhance transparency, promote regulatory compliance, and provide institutional continuity for AI-related scholarship in business education.

6. **Strengthen Regional and International Research Integration:** Active participation in regional and global AI research networks will enable Nigerian universities to leverage shared infrastructure, collaborative grants, and cross-border expertise. Strategic partnerships with international institutions can facilitate joint publications, faculty exchanges, co-supervised doctoral research, and access to advanced

computational platforms. Such integration enhances global visibility, improves research quality, and accelerates technology diffusion.

Collectively, these recommendations underscore that effective AI deployment in Nigerian business education research demands coordinated reform across fiscal policy, infrastructure development, governance systems, and human capital formation. A fragmented or incremental approach will yield limited impact. By contrast, sustained and strategically aligned investment can reposition Nigerian tertiary institutions as credible contributors to global AI scholarship and innovation-driven economic development.

### **Conflict of Interest**

The authors declare no potential conflict of interest concerning the research, authorship, and/or publication of this paper. All procedures and analyses were conducted objectively, and no financial or personal relationships influenced the study outcomes.

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