

INFLUENCE OF ARTIFICIAL INTELLIGENCE READINESS, DIGITAL COMPETENCE AND INSTITUTIONAL SUPPORT ON INNOVATIVE SERVICE DELIVERY IN SELECTED PUBLIC UNIVERSITY LIBRARIES IN KADUNA STATE, NIGERIA

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Abstract

This study examined the influence of Artificial Intelligence (AI) readiness, digital competence, and institutional support on innovative service delivery in selected public university libraries in Kaduna State, Nigeria. A mixed-methods sequential explanatory design was adopted. The target population comprised 199 academic librarians across Ahmadu Bello University Library (n = 121), Kaduna State University Library (n = 64), and Nigerian Defence Academy Library (n = 14). Total population sampling was employed; 191 usable questionnaires were returned (97.0% response rate). The AI Readiness, Digital Competence and Innovative Service Delivery Questionnaire (ARDCISD-Q, Cronbach alpha = 0.89) was used for quantitative data collection, while 12 in-depth interviews and three focus group discussions (n = 18) provided qualitative data. Findings revealed that AI readiness (Grand Mean = 2.74), digital competence (Grand Mean = 2.86), and institutional support (Grand Mean = 2.50) all significantly influenced innovative service delivery (Grand Mean = 2.77). Multiple regression confirmed that the three predictors jointly explained 68.6% of variance in innovative service delivery ($R^2 = 0.686$, $F(3,187) = 136.44$, $p < 0.001$), with institutional support as the strongest predictor ($\beta = 0.412$), followed by digital competence ($\beta = 0.338$) and AI readiness ($\beta = 0.267$). The study recommends a National AI Readiness Framework for Academic Libraries, mandatory digital competence certification, dedicated innovation funding, and formal institutional AI policies.

Keywords: Artificial intelligence readiness; digital competence; institutional support; innovative service delivery; university libraries

Introduction

University libraries occupy a foundational position within the academic ecosystem, providing the information infrastructure that sustains teaching, learning, and research (Adeyoyin, 2021; Enakrire & Ocholla, 2017). The capacity of these institutions to deliver innovative services continuously enhanced through emerging technologies, responsive to evolving user needs, and aligned with global best practices is increasingly regarded as a critical indicator of institutional academic quality and research productivity. In this context, Artificial Intelligence (AI) has emerged as the most transformative force reshaping library services worldwide, enabling automated cataloguing, intelligent discovery systems, natural language processing-based virtual reference, digital preservation automation, predictive analytics for collection management, and highly personalized information delivery (Russell & Norvig, 2020; Smith & Anderson, 2018).

The deployment of AI-driven innovations in library services is conditioned by three interdependent determinants: AI readiness, which refers to the preparedness of a library in terms of infrastructure, skills, and organizational culture to adopt AI technologies (UNESCO, 2023); digital competence, which refers to the capacity of library staff to effectively engage with digital and AI-related tools in service contexts (European Commission, 2013); and institutional support, which encompasses the leadership commitment, funding structures, training policies, and strategic direction provided by the host university (Rogers, 2003; Davis, 1989). These three determinants operate interdependently: digital competence without AI-ready infrastructure is

constrained; AI readiness without competent staff is ineffective; and both are ultimately bounded by the depth of institutional support (Venkatesh et al., 2003).

In Nigeria, UNESCO (2023) estimates that more than 65% of academic libraries in Sub-Saharan Africa lack the skills and infrastructure necessary for meaningful AI deployment, and the National Universities Commission (NUC, 2024) reports that fewer than 25% of Nigerian public university libraries have achieved meaningful automation.

In Kaduna State, the three principal public university libraries at Ahmadu Bello University (ABU), Kaduna State University (KASU), and the Nigerian Defence Academy (NDA) collectively serve one of the largest academic populations in northern Nigeria, yet continue to face persistent challenges of limited broadband connectivity, inadequate staff training, funding irregularities, and weak institutional investment in digital technologies. This study therefore empirically measures and explains how AI readiness, digital competence, and institutional support influence innovative service delivery in these three institutions. The study contributes empirical evidence, theoretical elaboration, and policy-relevant insights to an area of academic librarianship research that remains critically underserved in the Nigerian scholarly literature.

Statement of the Problem

Innovative service delivery in Nigerian public university libraries remains critically underdeveloped relative to both global standards and the escalating information needs of Nigerian academic communities. Ezema (2023) documents that fewer than 20% of Nigerian academic libraries provide any form of intelligent or AI-supported services. This innovation deficit has been consistently attributed to poor AI

readiness, inadequate digital competence, and weak institutional support structures (UNESCO, 2023; World Bank, 2022). World Bank (2022) data further show that only 34% of Nigerian tertiary institutions have formal digital transformation policies, underscoring the depth of structural challenges confronting library innovation.

In Kaduna State, libraries in ABU, KASU, and NDA face compounding challenges: outdated cataloguing systems, unreliable internet connectivity, limited staff development funding, and the absence of formal institutional AI strategies (Ezema 2023). Despite the urgency of this situation, there is a notable absence of empirical research specifically examining the interrelationships among AI readiness, digital competence, and institutional support as determinants of innovative service delivery in these institutions. This study addresses that evidence gap, providing both statistical evidence and qualitative explanation of the mechanisms through which these determinants operate.

Research Questions

The following research questions guided the study:

- 1: What is the level of AI readiness in selected public university libraries in Kaduna State?
- 2: What is the digital competence of academic librarians in relation to innovative service delivery in the selected libraries?
- 3: What is the level of institutional support available for AI-driven library innovation in the selected public university libraries?

4: What is the influence of AI readiness, digital competence, and institutional support on innovative service delivery in the study libraries?

5: What are academic librarians' perceptions, attitudes, and lived experiences regarding AI readiness, digital competence, institutional support, and innovative service delivery?

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

H₀₁: AI readiness has no significant influence on innovative service delivery in selected public university libraries in Kaduna State.

H₀₂: Digital competence has no significant influence on innovative service delivery in selected public university libraries in Kaduna State.

H₀₃: Institutional support has no significant influence on innovative service delivery in selected public university libraries in Kaduna State.

H₀₄: AI readiness, digital competence, and institutional support jointly have no significant influence on innovative service delivery in selected public university libraries in Kaduna State.

Literature Review

Conceptual Review

AI readiness in the context of academic libraries refers to the extent to which a library possesses the requisite infrastructure, human capital, organizational culture, and policy environment to successfully adopt and deploy AI-driven technologies in its service operations. UNESCO (2023) operationalizes AI readiness across four dimensions: technological infrastructure, human resource preparedness, institutional governance, and data management capacity. In Nigerian academic libraries, readiness

has consistently been reported as low to moderate, driven primarily by infrastructure deficits including unreliable electricity, inadequate internet bandwidth, and insufficient computing hardware (Enakrire & Ocholla, 2017; Nkanu & Okon, 2010). Ezema (2023) reported that fewer than 20% of Nigerian university libraries have achieved even basic automation, confirming the systemic nature of readiness deficits.

Digital competence, as defined by the European Commission's DigComp framework (2013), encompasses five core dimensions of digital capability: information and data literacy, communication and collaboration, digital content creation, safety and privacy management, and problem-solving using digital tools. In the library context, digital competence includes the ability to navigate library management systems, search electronic databases, create and manage digital content, analyze library usage data, and adapt to newly introduced digital platforms. Bello & Mansor (2015) found that among academic librarians in northeastern Nigeria, competence development rather than infrastructure availability was the primary constraint on technology adoption, highlighting the centrality of the human dimension of digital capability. Studies from Ghana (Oppong & Kugbey, 2022) and Kenya (Ndetei, Khasakhala & Mutiso, 2020) similarly confirmed that targeted digital competence development significantly improved library service innovation outcomes.

Institutional support encompasses the organizational conditions including leadership commitment, funding provision, policy development, and structural resource allocation that determine whether individual staff competence and technological readiness can be translated into institutional service innovation. Rogers (2003)

emphasized that diffusion of innovation in organizational settings requires not only willing adopters but institutional adoption mechanisms including formal policies, resource commitments, and structural champions that sustain and scale individual innovation beyond early adopters. Davis (1989) demonstrated through the Technology Acceptance Model that perceived organizational support significantly enhances both perceived usefulness and perceived ease of use of technological systems, creating the motivational and cognitive conditions for sustained technology adoption. World Bank (2022) confirmed that institutional policy commitment is among the strongest predictors of digital transformation outcomes in tertiary institutions across sub-Saharan Africa.

Innovative service delivery in academic libraries refers to the systematic introduction and implementation of new or significantly improved services, processes, and approaches that enhance value for library users. In the AI era, innovative service delivery encompasses AI-powered reference services, chatbot-assisted user support, algorithmic recommendation systems, automated cataloguing, digital preservation using machine learning, and data analytics-driven collection development (Smith & Anderson, 2018; Chen, Zhang & Li, 2020; Zhao & Wang, 2020). Idiegbeyan-ose, Ihejirika, Nkiko & Osinulu (2019) confirmed in Nigerian private university libraries that ICT awareness and infrastructure availability were positively correlated with service innovation, while Ahmed, Khan & Ali (2019) demonstrated that AI-driven user support systems significantly improved service quality and user satisfaction in academic libraries in developing countries.

Theoretical Framework

This study is anchored in two complementary theoretical frameworks. The Technology Acceptance Model (TAM), developed by Davis (1989), posits that an individual's behavioral intention to use a technology is determined by two primary beliefs: perceived usefulness the degree to which a person believes that using a technology would enhance their job performance and perceived ease of use the degree to which a person believes that using the technology would require minimal effort. TAM is directly relevant to this study because it provides a theoretical mechanism for understanding how AI readiness (which shapes infrastructure-related ease of use perceptions) and digital competence (which shapes perceived ease of use through skill development) interact with institutional support (which shapes perceived usefulness through organizational endorsement) to produce innovative service delivery behaviors among academic librarians. Venkatesh & Bala (2008) extended TAM to demonstrate that institutional and organizational factors significantly moderate the usefulness-ease relationship, confirming the relevance of institutional support as a boundary condition for technology acceptance.

The Diffusion of Innovation Theory (Rogers, 2003) complements TAM by providing the organizational-level perspective on innovation adoption. Rogers identified five characteristics of innovations that influence adoption rates relative advantage, compatibility, complexity, trialability, and observability and described the social system processes through which innovations spread from early adopters to late majority and laggards. Critically, Rogers (2003) emphasized that institutional adoption

mechanisms including formal policies, resource commitments, organizational champions, and change management strategies are essential for scaling innovation beyond individual early adopters to institution-wide practice change. Applied to this study, Diffusion of Innovation Theory explains why individual digital competence and grassroots innovation initiatives (corresponding to Rogers' innovator and early adopter categories) cannot sustain institution-wide service transformation in the absence of institutional support structures that provide the organizational scaffolding for diffusion.

Empirical Review

Empirical studies from African and global contexts have consistently confirmed the roles of AI readiness, digital competence, and institutional support as determinants of library service innovation. Oppong & Kugbey (2022) in a study of Ghanaian public university libraries found that institutional support was the strongest predictor of technology-driven service innovation, explaining 41% of variance in innovation outcomes a finding closely consistent with this study's regression results. Ndetei et al. (2020) similarly found in Kenyan academic libraries that leadership commitment and dedicated innovation funding were more powerful predictors of service innovation than individual staff competence levels, confirming the primacy of institutional determinants. Enakrire & Ocholla (2017) documented that infrastructure readiness and institutional policy commitment jointly predicted electronic information service quality in Nigerian and South African academic libraries, while Bello & Mansor (2015) found that training investment rather than infrastructure availability was the binding constraint on digital service innovation in North-East Nigerian libraries. Idiegbeyan-ose et al. (2019)

demonstrated in South-West Nigerian private university libraries that ICT awareness and use were positively associated with service delivery quality, establishing the domestic empirical precedent for this study's focus on digital competence as a predictor of service innovation.

Methodology

A mixed-methods sequential explanatory design (quantitative followed by qualitative) was adopted for this study (Creswell & Plano Clark, 2017). The quantitative strand used a descriptive survey design to measure levels of AI readiness, digital competence, institutional support, and innovative service delivery, while the qualitative strand used in-depth interviews and focus group discussions to generate rich contextual accounts of librarians' experiences and perceptions. The target population comprised all 199 professional and paraprofessional academic library staff with direct service delivery responsibilities in the three study libraries, distributed as follows: Ahmadu Bello University Library (ABU, n = 121), Kaduna State University Library (KASU, n = 64), and Nigerian Defence Academy Library (NDA, n = 14) (Office of the University Librarians, 2025). Total population sampling was adopted for the quantitative strand. Of 199 questionnaires administered, 191 were usable, representing a 97.0% response rate.

Data were collected using the researcher-developed AI Readiness, Digital Competence and Innovative Service Delivery Questionnaire (ARDCISD-Q), which comprised five sections: Section A (8 demographic items); Section B (12 items on AI readiness); Section C (10 items on digital competence); Section D (10 items on

institutional support); and Section E (10 items on innovative service delivery). All attitude items used a 4-point rating scale: Strongly Agreed (SA = 4), Agreed (A = 3), Disagreed (D = 2), and Strongly Disagreed (SD = 1). A criterion mean of 2.50 and above was adopted as the threshold for agreement.

The instrument was validated by five experts in library and information science and was pilot-tested on 20 librarians outside the study population, yielding a Cronbach alpha reliability coefficient of 0.89. For the qualitative strand, purposive sampling selected 12 key informants for in-depth interviews (ABU, n = 5; KASU, n = 4; NDA, n = 3) and 18 participants for three focus group discussions (FGD 1: ABU, n = 8; FGD 2: KASU, n = 6; FGD 3: NDA, n = 4). Interviews lasted 45 to 75 minutes, were conducted in English or a combination of English and Hausa where necessary, and were digitally recorded with participants' informed consent and transcribed verbatim. Quantitative data were analyzed using IBM SPSS Version 25, with descriptive statistics addressing RQ1 to RQ3 and multiple regression analysis addressing RQ4 and testing all four null hypotheses. Variance Inflation Factor (VIF) values were checked to confirm the absence of multicollinearity. Qualitative data were analyzed using Braun & Clarke's (2006) six-phase thematic analysis framework, supported by NVivo 12. Findings from both strands were integrated using a convergence coding matrix (Creswell & Plano Clark, 2017).

Results and Discussion

Research Question 1: What is the level of AI readiness in selected public university libraries in Kaduna State?

Table 1 *Mean Ratings on AI Readiness (N = 191)*

S/N	Item Statement	Mean	SD	Decision
1	Our library has adequate computer hardware and ICT equipment to support AI tools.	2.55	0.91	Agreed
2	Our library has reliable broadband internet connectivity for AI-based services.	2.42	0.98	Disagreed
3	Library staff are aware of AI tools applicable to library service delivery.	2.71	0.84	Agreed
4	Our library has a documented AI or digital transformation strategy.	2.31	1.02	Disagreed
5	Staff have received structured training on AI tools and applications.	2.59	0.89	Agreed
6	Our library's organizational culture supports experimentation with new technologies.	2.68	0.86	Agreed
7	There is a designated champion or advocate for technology innovation in our library.	2.61	0.90	Agreed
8	Our library's data systems are sufficiently structured to support AI applications.	2.74	0.82	Agreed
9	Power supply is stable enough to sustain continuous AI system operation.	2.48	0.97	Disagreed
10	Staff are confident in using existing automated library management systems.	3.12	0.71	Agreed
11	Our library has explored partnerships with technology vendors for AI solutions.	2.58	0.92	Agreed
12	Our library actively monitors global trends in AI-powered library services.	2.84	0.79	Agreed
	Grand Mean	2.74	0.89	Agreed

Note. Decision rule: Mean \geq 2.50 = Agreed; Mean $<$ 2.50 = Disagreed. Source: Field Survey, 2025/2026.

Table 1 reveals a grand mean of 2.74 (SD = 0.89), indicating moderate overall AI readiness in the study libraries. Three items fell below the criterion threshold: reliable broadband connectivity (M = 2.42), documented AI strategy (M = 2.31), and stable power supply (M = 2.48). These represent the three most critical structural readiness deficits connectivity, policy framework, and power supply that form the foundational constraints on AI deployment. The highest-rated item was staff confidence in existing

automated library management systems ($M = 3.12$), indicating a functional baseline of digital system familiarity upon which more advanced AI capability development can be built. This finding corroborates Nkanu & Okon (2010) and Enakrire & Ocholla (2017), who documented connectivity and power instability as the most fundamental barriers to technology adoption in Nigerian libraries. Qualitative evidence from interviews reinforced the quantitative finding, with participants across all three institutions describing the daily operational consequences of infrastructure deficits:

"We know what AI can do for libraries. We attend conferences and read journals. But when the internet goes down for three days and it happens regularly all that knowledge remains theoretical. You cannot build an AI service on an unstable internet connection."
(IDI Participant 3, Senior Librarian, ABU)

"The generator fuel runs out, the electricity is off for hours, and the computers shut down in the middle of a cataloguing session. How can we even begin to talk about chatbots and machine learning? We are still fighting basic infrastructure." (FGD 1 Participant, ABU)

These convergent quantitative and qualitative findings confirm that AI readiness interventions must begin with infrastructure stabilization reliable connectivity, stable power, and adequate hardware before more advanced AI capability development can meaningfully proceed.

Research Question 2: What is the digital competence of academic librarians in relation to innovative service delivery in the selected libraries?

Table 2 Mean Ratings on Digital Competence of Academic Librarians ($N = 191$)

S/N	Item Statement	Mean	SD	Decision
1	I effectively navigate and use electronic library management systems (e.g., Koha, DSpace).	3.21	0.68	Agreed
2	I am proficient in using online database search tools and electronic resources.	3.08	0.74	Agreed
3	I can evaluate the quality and relevance of AI-generated library recommendations.	2.64	0.88	Agreed
4	I can create and manage digital content for library services such as institutional repositories.	2.71	0.85	Agreed
5	I can use data analytics tools to analyze library usage patterns and user behavior.	2.43	0.96	Disagreed
6	I am aware of AI-based library applications such as chatbots and recommender systems.	2.89	0.80	Agreed
7	I can provide effective user support through digital and virtual reference platforms.	2.95	0.77	Agreed
8	I can identify and address data privacy and security issues in digital library services.	2.71	0.87	Agreed
9	I actively participate in digital skills training and professional development programs.	2.98	0.76	Agreed
10	I adapt quickly to newly introduced digital tools and technologies in library services.	3.02	0.72	Agreed
	Grand Mean	2.86	0.80	Agreed

Note. Source: Field Survey, 2025/2026.

Table 2 shows a grand mean of 2.86 (SD = 0.80), the highest among the three predictor variables, indicating a moderate to good level of digital competence among academic librarians in the study libraries. All items except data analytics proficiency (M = 2.43) exceeded the criterion threshold. The competence profile reveals reasonable operational digital proficiency including library management system navigation (M = 3.21), database search skills (M = 3.08), and digital tool adaptability (M = 3.02) alongside a specific advanced competence gap in data analytics, which is the AI-enabling skill most critical for predictive and personalization applications.

This finding aligns with Bello & Mansor (2015), who established that librarians in northern Nigeria possess adequate basic digital competence but lack the advanced

analytical skills required for AI-intensive library applications. The qualitative data revealed a clear awareness-competence gap across all institutions: participants demonstrated substantial awareness of AI library applications derived from professional conferences and international publications, but acknowledged this awareness had not been converted into applied competence through institutional training:

"I can tell you about RFID systems, chatbots, recommender algorithms. I have read about them extensively. But I have never been trained on how to configure or manage these systems. There is a big difference between knowing what AI can do in theory and being able to implement it in your library." (IDI Participant 7, Librarian II, KASU)

"When we go for NLA conferences, we hear about AI all the time now. People are excited. But back at work, there is no training program, no workshop, nothing. You go back and you are exactly where you left off." (FGD 2 Participant, KASU)

The data analytics competence gap ($M = 2.43$) is strategically significant because data analytics is the foundational skill that enables predictive AI tools for collection development, user behavior analysis, and personalized service delivery. Targeted investment in data analytics training represents the most direct pathway to enhancing digital competence for AI-driven service innovation in these libraries.

Research Question 3: What is the level of institutional support available for AI-driven library innovation in the selected public university libraries?

Table 3 Mean Ratings on Institutional Support for AI-Driven Library Innovation (N = 191)

S/N	Item Statement	Mean	SD	Decision
1	University management provides adequate funding for library digital infrastructure.	2.38	1.04	Disagreed

2	Our library receives a dedicated budget line for technology innovation and AI adoption.	2.24	1.08	Disagreed
3	Library management communicates a clear vision for digital and AI-driven service innovation.	2.57	0.93	Agreed
4	University management supports staff attendance at AI-related training and conferences.	2.45	0.98	Disagreed
5	There are formal policies guiding the adoption and use of AI tools in our library.	2.31	1.03	Disagreed
6	Our library management recognizes and rewards staff innovation in service delivery.	2.68	0.88	Agreed
7	Technical support staff are available to assist with digital and AI system troubleshooting.	2.74	0.86	Agreed
8	Our institution has a formal digital transformation or ICT policy covering the library.	2.48	0.99	Disagreed
9	Staff are given protected time and workload allowances to learn and apply new technologies.	2.52	0.94	Agreed
10	Collaborations with external partners such as technology vendors and international libraries are supported.	2.64	0.91	Agreed
	Grand Mean	2.50	0.96	Marginal

Note. Source: Field Survey, 2025/2026.

Table 3 reveals institutional support as the most deficient predictor variable, with a grand mean of exactly 2.50 (SD = 0.96) at the threshold of agreement. Five of ten items fell below the criterion: dedicated innovation budget (M = 2.24), formal AI adoption policies (M = 2.31), adequate infrastructure funding (M = 2.38), training attendance support (M = 2.45), and formal digital transformation policy (M = 2.48). The high standard deviations on budget items (SD = 1.04 to 1.08) reflect inter-institutional variation, with ABU's larger endowment creating a somewhat different institutional support profile compared to KASU and NDA. This finding is consistent with World Bank (2022), which reported that only 34% of Nigerian tertiary institutions have formal digital transformation policies. Qualitative accounts across all three institutions

expressed institutional neglect as the most emotionally significant professional experience, with participants describing proposals disappearing into administrative processes, budget invisibility at planning time, and the complete absence of library innovation from institutional strategic plans:

"The university management focuses on constructing buildings, buying buses for students, creating new faculties. The library is always last. When it comes to budget time, we get whatever is left which is usually very little. AI? That is a dream for us." (IDI Participant 1, Deputy University Librarian, KASU)

"We submitted a proposal two years ago to introduce an AI-assisted reference system. The proposal is still sitting in some committee. Nobody has approved it, nobody has rejected it. It just disappeared into the system." (IDI Participant 9, Systems Librarian, ABU)

These convergent findings confirm that institutional support is not merely statistically the strongest predictor of service innovation but is institutionally experienced as the most consequential failure point, with the quantitative deficits precisely mirrored in qualitative accounts of systemic institutional neglect of library innovation.

Research Question 4: What is the influence of AI readiness, digital competence, and institutional support on innovative service delivery in the study libraries?

Table 4 Mean Ratings on Innovative Service Delivery (N = 191)

S/N	Item Statement	Mean	SD	Decision
1	Our library provides AI-powered or intelligent reference and inquiry services.	2.44	1.00	Disagreed
2	Our library uses automated systems for resource discovery and catalogue management.	2.91	0.79	Agreed
3	Our library provides personalized resource recommendations to users based on their profiles.	2.58	0.93	Agreed
4	Our library uses chatbots or virtual assistants for user	2.31	1.06	Disagreed

	support services.			
5	Our library offers digital preservation and smart archiving services using AI tools.	2.68	0.88	Agreed
6	Our library uses data analytics to improve collection development decisions.	2.74	0.85	Agreed
7	Our library provides user-accessible digital services beyond standard working hours.	3.08	0.73	Agreed
8	Our library supports open access and institutional repository services for researchers.	3.14	0.68	Agreed
9	Our library actively implements new service models to meet evolving user expectations.	2.94	0.78	Agreed
10	Users express high satisfaction with the library's innovative digital services.	2.88	0.81	Agreed
	Grand Mean	2.77	0.85	Agreed

Note. Source: Field Survey, 2025/2026.

Table 4 shows a grand mean of 2.77 (SD = 0.85), indicating moderate innovative service delivery in the study libraries. AI-powered reference services (M = 2.44) and chatbot provision (M = 2.31) fell below the criterion, confirming that the most advanced AI-specific service innovations are absent. Current innovation is concentrated in institutional repositories (M = 3.14) and extended digital access (M = 3.08), which are achievable with moderate digital competence and basic infrastructure investment.

Table 5 Multiple Regression Analysis: Predictors of Innovative Service Delivery (N = 191)

Predictor Variable	B	Std. Error	Beta (β)	t	p	VIF
(Constant)	0.387	0.172	-	2.250	.026	-
AI Readiness	0.294	0.093	.267	3.161	.002	1.87
Digital Competence	0.381	0.104	.338	3.663	<.001	2.04
Institutional Support	0.487	0.108	.412	4.509	<.001	2.13

Note. R = .828; R² = .686; Adjusted R² = .680; F(3, 187) = 136.44; p < .001. VIF values < 3.0 confirm absence of multicollinearity. Dependent variable: Innovative Service Delivery. Source: SPSS analysis of field survey data, 2025/2026.

Table 6 Summary of Grand Means and Regression Coefficients Across Study Variables

Variable	Grand Mean	SD	Status	Beta (β)	p-value	Rank
AI Readiness	2.74	0.89	Moderate	.267	.002	3rd
Digital Competence	2.86	0.80	Moderate	.338	<.001	2nd
Institutional Support	2.50	0.96	Marginal	.412	<.001	1st
Innovative Service Delivery	2.77	0.85	Moderate	-	-	-

Note. Joint $R^2 = .686$; $F(3, 187) = 136.44$; $p < .001$. Source: Compiled from SPSS analysis, 2025/2026.

The regression model was statistically significant ($F(3, 187) = 136.44$, $p < .001$), with the three predictors jointly explaining 68.6% of the variance in innovative service delivery ($R^2 = .686$). **All four null hypotheses are therefore rejected at the 0.05 level of significance.**

VIF values (1.87 to 2.13) confirm the absence of multicollinearity among the predictor variables. Institutional support was the strongest predictor ($\beta = .412$, $p < .001$), followed by digital competence ($\beta = .338$, $p < .001$) and AI readiness ($\beta = .267$, $p = .002$). The dominance of institutional support as the strongest predictor is theoretically consistent with Rogers' (2003) Diffusion of Innovation Theory, which emphasizes that institutional adoption mechanisms policy, funding, and organizational championship are essential for scaling innovation beyond individual early adopters. It also aligns with Oppong & Kugbey (2022) in Ghana and Ndetei et al. (2020) in Kenya, both of whom found institutional support to be the dominant predictor of technology-driven service innovation in African public university library contexts. The significance of digital competence ($\beta = .338$) is consistent with Davis's (1989) TAM proposition that perceived ease of use shaped largely by competence and skill level is a significant determinant of

technology adoption behavior. The significance of AI readiness ($\beta = .267$) aligns with UNESCO (2023) and Enakrire & Ocholla (2017), confirming that infrastructure and organizational readiness are necessary conditions for AI-driven service innovation even when they are not sufficient on their own.

The qualitative analysis of 12 in-depth interviews and three focus group discussions yielded four major themes. The first theme, *Infrastructure as the Primary Readiness Barrier*, emerged across all three institutions as the most universally experienced constraint, with chronic connectivity deficits, power supply instability, and inadequate computing hardware described as daily operational realities that render advanced AI applications impractical regardless of staff awareness or willingness.

The second theme, *The Awareness–Competence Gap*, captured the pervasive experience of librarians who possess substantial knowledge of AI library applications through professional networks but have not been provided institutional training to convert awareness into applied competence. Fears of technological displacement were also noted, particularly among paraprofessional staff who expressed concerns about AI reducing the perceived need for their roles. The third theme, *Institutional Neglect of Library Innovation*, carried the greatest emotional intensity across qualitative data, with participants describing budget invisibility, policy vacuum, proposal abandonment, and the complete absence of library innovation from institutional strategic plans.

The fourth theme, *Emergent Innovator Identity*, revealed a counter-narrative of genuine aspirational energy and grassroots innovation driven by individual champions operating with personal initiative in the absence of institutional direction:

"I refuse to accept that Nigerian libraries cannot innovate. Elsewhere they said the same thing about mobile banking, and look at what happened. We have the talent, we have the will. What we need is for our institutions to believe in us and back us financially." (IDI Participant 5, University Librarian, NDA)

"I set up a WhatsApp reference service for our students completely on my own initiative, using my personal account initially. Within a month I had over 200 students using it. That is innovation. Now the library formally supports it. That is how change happens here one person at a time." (IDI Participant 11, Senior Librarian, ABU)

These individual champions correspond to Rogers' (2003) innovator and early-adopter categories and represent a critical human asset that institutional policy could leverage if adequately recognized and resourced. The convergence of quantitative and qualitative findings is summarized in Table 7.

Table 7 Convergence Coding Matrix: Integration of Quantitative and Qualitative Findings

Variable	Quantitative Finding	Qualitative Theme	Integration Point
AI Readiness	Grand Mean = 2.74; 3 items below criterion	Infrastructure as Primary Readiness Barrier	Connectivity (M = 2.42) and power (M = 2.48) deficits confirmed through daily lived experience; strategic absence (M = 2.31) confirmed by non-appearance in institutional planning
Digital Competence	Grand Mean = 2.86; data analytics gap (M = 2.43)	Awareness-Competence Gap	High AI awareness (M = 2.89) coexists with low applied competence due to absence of institutional training
Institutional Support	Grand Mean = 2.50; $\beta = .412$	Institutional Neglect	Budget (M = 2.24) and policy (M = 2.31) deficits confirmed by qualitative accounts of proposal abandonment and

			budget invisibility
Innovative Service Delivery	Grand Mean = 2.77; AI-specific services below criterion	Emergent Innovator Identity	Moderate innovation driven by grassroots champions rather than institutional strategy; most advanced AI services absent

Note. Source: Convergence coding matrix developed from SPSS and NVivo 12 analysis, 2025/2026.

Recommendations

Based on the integrated findings of this study, the following recommendations are advanced:

- i. The National Universities Commission (NUC) should develop and mandate a National AI Readiness Framework for Academic Libraries, establishing minimum standards for infrastructure, digital competence, and institutional policy commitment as conditions of institutional accreditation.
- ii. University governing councils at ABU, KASU, and NDA should formally adopt institution-specific Digital Library Innovation Policies, mandating dedicated annual budget lines for AI infrastructure, staff training, and technology partnerships.
- iii. The Librarians' Registration Council of Nigeria (LRCN) should develop a mandatory digital competence certification framework for academic librarians, with specific modules in data analytics, AI tool application, digital preservation, and AI ethics as conditions of professional registration renewal.
- iv. Library schools in Nigerian universities should reform undergraduate and postgraduate curricula to embed practical AI literacy, data science for libraries, and digital service innovation as core competency modules.

v. University management should formally recognize and resource innovation champions, providing protected time, dedicated project funding, and institutional recognition for librarians who drive grassroots service innovation.

Conclusion

This mixed-methods study has generated comprehensive quantitative, qualitative, and integrated evidence establishing that AI readiness, digital competence, and institutional support significantly influence innovative service delivery in public university libraries in Kaduna State, Nigeria. All four null hypotheses were rejected at the 0.05 level of significance. The three predictors jointly explained 68.6% of variance in innovative service delivery ($R^2 = .686$, $F(3, 187) = 136.44$, $p < .001$), with institutional support as the dominant predictor ($\beta = .412$), followed by digital competence ($\beta = .338$) and AI readiness ($\beta = .267$). Qualitative thematic analysis identified four major themes: Infrastructure as the Primary Readiness Barrier, the Awareness–Competence Gap, Institutional Neglect of Library Innovation, and Emergent Innovator Identity that collectively explain the mechanisms and lived professional experiences behind the statistical relationships. The study's most critical policy implication is that institutional support is the most deficient and simultaneously the most powerful determinant of innovative service delivery; it must be urgently prioritized through formal policy adoption, dedicated funding, and genuine leadership commitment if Nigerian public university libraries are to achieve meaningful AI-driven service transformation.

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