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# TRANSFORMING NIGERIAN LIBRARIES INTO AI-DRIVEN INNOVATION HUBS: A SYSTEMATIC REVIEW OF TRENDS, OPPORTUNITIES, AND CHALLENGES

**Juliana Iwu James**
juliana@gouni.edu.ng

and
**Ayo Nnenna Mercy**
ayonnennamercy@gouni.edu.ng
Godfrey Okoye University Enugu

*Abstract*

The rapid growth of artificial intelligence (AI) is reshaping the global knowledge ecosystem, encouraging libraries to evolve from traditional information repositories into dynamic innovation hubs. In Nigeria, this transition is particularly urgent as libraries confront increasing demands for digital services, inclusive learning spaces, and technologically enhanced research environments. This systematic review synthesizes empirical and conceptual studies published between 2019 and 2025 with the aim to examine how Nigerian libraries are adopting AI, redesigning services, and positioning themselves as innovation-driven institutions. This research was guided by the PRISMA methodology, in which 32 publications, including journal articles, conference papers, and book chapters, were analyzed to identify emerging trends, opportunities, and systemic challenges. The review reveals that AI is enabling automated cataloguing, predictive user analytics, intelligent information retrieval, personalized support, and community-focused innovation programs. However, infrastructural limitations, inadequate AI competencies among library personnel, funding deficits, and the absence of clear regulatory frameworks constrain transformational progress. The study proposes a structured model for transforming Nigerian libraries into AI-driven, socially inclusive innovation hubs and outlines key implications for policy development, library practice, professional training, and future research.

## Introduction

The digital age, coupled with the rapid rise of artificial intelligence (AI), is reshaping the landscape of library and information services worldwide, catalyzing a transformation from conventional repositories of knowledge to dynamic innovation hubs that actively promote research collaboration, digital literacy, and social engagement (Meesad & Mingkhwan, 2024; Adarkwah et al., 2024). In Nigeria, the accelerated development of digital infrastructures, coupled with the adoption of AI solutions, presents both immense opportunities and significant challenges for libraries navigating the Fourth Industrial Revolution (4IR). These technological advances offer Nigerian libraries a unique chance to enhance their strategic relevance, expand user reach, and foster societal innovation, while simultaneously highlighting structural, skill-based, and policy-related barriers that must be addressed to ensure effective adoption.(Isiaka, Soliu, Aremu, Bamidele, Saba-Jibril, & Ibitoye, 2024; Suleiman, 2024)

This systematic review synthesizes studies conducted between 2019 and 2025, focusing

specifically on the integration of AI in Nigerian libraries and the ways these institutions are transitioning into AI-powered innovation hubs. The synthesis highlights a clear trend: Nigerian libraries are moving beyond static custodianship of knowledge to becoming proactive, responsive, and innovative spaces, leveraging AI, machine learning, and digital platforms to support academic research, learning, and societal advancement (Adigun et al., 2024).

Collectively, these AI-driven transformations underscore the potential of Nigerian libraries to reinvent themselves as innovation hubs; bridging the gap between digital literacy; technological adoption, and social impact. Through the strategic deployment of AI, libraries can facilitate inclusive knowledge access; support research excellence; and cultivate innovation ecosystems, thereby ensuring that they remain relevant and effective in a rapidly evolving global knowledge economy (Oso, Adeoye, & Kolawole, 2025; Tizhe, 2025).

## Research Gaps

Systematic reviews provide structured, evidence-based insights into AI-driven innovation, but there appears to be a lack of a consolidated body of systematic research capable of informing national or institutional frameworks for AI adoption from Nigerian library researchers. This disparity highlights a significant methodological and contextual gap: while global scholarship benefits from rigorous systematic reviews that synthesize diverse findings and produce actionable models, Nigerian library research has not yet employed systematic review methodologies to holistically examine AI readiness, challenges, opportunities, and pathways for transformation. As a result, there is limited empirical guidance on how Nigerian libraries can transition into AI-driven innovation hubs that balance technological advancement with equitable access, human-centered services, and societal impact. Addressing this gap requires a comprehensive systematic review of studies published between 2019 and 2025. Such an inquiry is crucial for identifying best practices, contextual challenges, and strategic interventions that can help Nigerian libraries align with international standards of AI-enabled development innovation.

## Research Objectives

This review aims to:

1. Examine recent AI applications in Nigerian libraries (2019–2025).
2. Examine how libraries are transforming into inclusive, AI-driven innovation hubs
3. Identify barriers and enablers for AI adoption.
4. Develop a conceptual framework for AI-enabled library redesign.

## Methodology

This systematic review was conducted following PRISMA guidelines (Moher et al., 2009):

- Databases Searched: Scopus, Web of Science, AJOL, Google Scholar, and Nigerian university repositories.
- Inclusion Criteria: Peer-reviewed studies, dissertations, and conference proceedings from 2019–2025 focusing on Nigerian libraries and AI applications.
- Exclusion Criteria: Studies outside Nigeria or unrelated to AI or library innovation.
- Search Terms: "AI AND Nigerian libraries", "digital transformation AND libraries Nigeria", "innovation

hubs AND libraries", "4IR/5IR AND library services".

- Data Extraction: Author(s), year, library type, AI technology, study design, findings, challenges, and recommendations.

**Table 1: PRISMA Flow Summary:**

| Stage | Records | Inclusion/Exclusion |
|---|---|---|
| Records identified | 132 | Database and manual search |
| Duplicates removed | 18 | 114 screened |
| Full-text assessed | 82 | 32 included |
| Final studies | 32 | Met inclusion criteria |

## RESULTS (THEMATIC SUMMARY)

## AI APPLICATIONS IN NIGERIAN LIBRARIES

### Chatbots and Virtual Reference Services

Round-the-Clock Assistance: AI-powered chatbots and virtual reference platforms provide libraries with 24/7 support for various services, including reference queries, circulation management, and database navigation. This constant availability benefits users, particularly students and researchers, who require assistance beyond traditional working hours.

Enhanced User Engagement and Satisfaction: Chatbots deliver instant responses and personalized guidance, improving user satisfaction and fostering deeper engagement with library services. Their ability to adapt to user behavior and remember past interactions promotes a more interactive library experience.

Support for Complex Research Needs: Advanced AI chatbots triage inquiries, escalating complex queries to professional librarians, allowing these professionals to focus on in-depth research support and information literacy training. Data-Driven Insights: Chatbots collect and analyze interaction data, helping libraries identify frequent questions, service gaps, and trends in user behavior, thereby informing service improvement and digital resource acquisition. Integration with Digital Learning Ecosystems: In academic settings, chatbots enhance e-learning platforms and research management systems, aiding students and faculty in navigating digital resources. This integration positions libraries as vital, technology-enabled support centers that connect traditional and digital knowledge services (Adewojo, & Dunmade, 2024; Adewojo, Amzat, & Abiola, 2025; Adetayo, 2023; Akobe., Adeboye, Dauda, & Yacim, 2025; Kotso, 2025; Sinha, & Ugwulebo, 2024)

**Predictive Analytics**

Optimizing collection development and resource allocation through predictive analytics involves using AI algorithms to analyze circulation data, resource usage patterns, and user preferences. This allows libraries to make informed decisions about collection growth, acquisition priorities, and resource sharing, ensuring collections stay relevant and aligned with user needs while reducing spending on less-used materials. Additionally, predictive analytics improves circulation planning and operational efficiency by identifying trends in borrowing behavior, peak usage times, and user engagement with digital collections. This helps libraries anticipate demand changes and optimize staffing, service hours, and space management. Furthermore, AI-driven predictive tools support data-based management decisions by offering actionable insights for budget planning, program development, and service improvements, fostering a culture of informed decision-making. These tools also enable personalized user services by providing tailored recommendations, which enhance user experience and encourage engagement with library resources, especially in research-focused environments. Finally, integrating predictive analytics with institutional planning positions academic libraries as key decision-makers, transforming them into proactive knowledge hubs that support institutional goals like research assistance and learning analytics.(Akanbiemu, 2024; Bassey & Daniel, 2024; Monyela, & Tella,2024; Tella, Dunmade, Ajani, & Abdullahi, 2025)

**Intelligent Cataloguing and Metadata Management**

Automation in libraries through AI-powered systems enhances classification and indexing by reducing time and effort and improving accuracy in metadata assignment. Machine learning algorithms facilitate the analysis of resource content and relationships, resulting in consistent subject headings and minimized classification errors, ultimately boosting user satisfaction. AI-enabled metadata supports efficient resource retrieval via intelligent search and natural language processing, enabling precise user queries. Additionally, intelligent cataloguing evolves with new data, adapting classifications for digital collections. This AI-driven approach fosters interoperability among repositories and libraries, enhancing open access and global knowledge engagement, thus reinforcing libraries' roles in research and institutional competitiveness (Abubakar, et al. 2024; Oyighan, Ukubeyinje, David-West, & Oladokun, 2024).

**Social Innovation and Community Engagement**

Libraries are evolving into centers for social innovation, leveraging AI and digital tools to foster knowledge ecosystems that enable co-creation and community development. They promote digital literacy, particularly in underserved communities, through AI-driven resources like tutorials and chatbots, enhancing users' engagement with technology. AI tools also improve personalized research support and promote academic collaboration, establishing libraries as essential partners in scholarship. Moreover, AI-enabled libraries tailor programs to address community needs, fostering inclusivity and bridging knowledge gaps. By utilizing data to inform social programs, libraries emerge as proactive agents of social change, contributing to lifelong learning and civic engagement while integrating with larger knowledge networks to bolster socio-economic development (Adigun, Ajani, & Enakrire, 2024; Ajani,

Tella, & Oladokun, 2024; Diseiye, Ukubeyinje, Oladokun, & Kakwagh, 2024; Ifijeh, Iwu-James, Izuagbe & Nwaogu, 2019; Iwu-James & Yacob, 2023; Iwu-James et al. 2023 ; Oyeronke, Iwu-James, & Olajumoke, 2019).

**Table 2:** ***AI Applications in Nigerian Libraries (2019–2025)***

| Author(s) | Library Type | AI Technology | Purpose | Key Findings |
|---|---|---|---|---|
| Adewojo et al., 2025 | Academic/Public | Chatbots, NLP | Reference & circulation | Increased accessibility, user satisfaction |
| Tella et al., 2025 | Academic | Predictive analytics | Collection development | Optimized resource allocation |
| Ojobor et al., 2025 | Academic | Intelligent cataloguing | Metadata management | Reduced errors, improved efficiency |
| Ajani, Tella, & Oladokun, 2024 | Public | Social innovation | Inclusivity & diversity | Libraries as innovation hubs |

## NIGERIAN LIBRARIES AS INNOVATION HUBS

Nigerian libraries are increasingly adopting AI technologies to reinvent their traditional roles, shifting from mere storage and retrieval centers to dynamic hubs for social innovation, research collaboration, and knowledge co-creation. This transformation aids in fostering strategic partnerships with industries and educational institutions, enhancing service delivery and promoting AI literacy among users and staff. AI tools also enable libraries to analyze user data for evidence-based decision-making, improving services by personalizing recommendations and curating tailored learning experiences. Furthermore, libraries act as catalysts for knowledge co-creation, encouraging community engagement and lifelong learning. The integration of AI allows for enhanced organizational agility, facilitating real-time monitoring and adaptive service models to meet evolving user demands and ensure libraries remain relevant in a digital, AI-driven knowledge economy ( Ikwuanusi, Adepoju, & Odionu, 2023; Ojobor, Okafor, & Ugwuanyi, 2025; Okoye, 2024; Oladokun, Ogunjimi, Oyetola, Orubebe, & Enakrire, 2025; Suleiman, 2024).

### Challenges in AI Adoption

1. Infrastructure Deficits: Inadequate ICT infrastructure, unreliable electricity, and limited internet connectivity (Isiaka et al., 2024; Ubochi & Soroibe, 2024).
2. Skill Gaps: Librarians require training in AI, machine learning, and data analytics (Oladokun et al., 2025; Adewojo et al., 2025).
3. Policy Limitations: Limited ethical guidelines, governance frameworks,

and AI inclusion policies (Ajani et al., 2024; Adarkwah et al., 2024).

4. Digital Divide: User access and digital literacy vary, potentially limiting equitable AI adoption (Suleiman, 2024).

**Opportunities and Best Practices**

The document discusses the transformative impact of AI on libraries through several key dimensions. Firstly, AI-powered chatbots and virtual reference services enhance user experience by providing 24/7 support, personalized guidance, and immediate answers, which improve user engagement and accessibility. Secondly, predictive analytics enable efficient resource management by allowing libraries to anticipate user needs and optimize collections, ensuring data-driven decision-making and operational efficiency. Thirdly, AI aids in developing inclusive social programs tailored to diverse user groups, promoting equitable access to knowledge and fostering active participation in community initiatives. Furthermore, strategic partnerships with universities and technology providers enhance libraries' capacity for AI implementation and innovation, providing essential resources and expertise. Lastly, the integration of AI across library functions transforms them into holistic knowledge ecosystems, aligning with global trends while serving as academic enablers and community innovators. This multifaceted approach positions libraries to effectively meet evolving demands and contribute to societal development (Adewojo, Amzat, & Abiola, 2025; Adigun, Ajani, & Enakrire, 2024; Tella, Dunmade, Ajani, & Abdullahi, 2025; Okoye, 2024)

## CONCEPTUAL FRAMEWORK

The conceptual framework for AI-enabled library redesign in Nigeria advocates for transitioning from traditional services to AI-centric innovation hubs. It comprises five components: Technology, Human Capital, Policy & Governance, Social Innovation, and Partnerships, each essential for sustainable and ethical AI implementation.

- Technological Infrastructure: Focuses on integrating AI tools such as chatbots and predictive analytics to enhance library services and efficiency.

- Human Capital Development: Emphasizes continuous training for librarians in AI literacy and data management to overcome skill gaps.

- Policy and Governance Framework: Highlights the need for robust ethical guidelines and governance structures to ensure responsible AI use and user protection.

- Social Innovation: Positions libraries as centers for community engagement and empowerment through initiatives that promote digital literacy and inclusivity.

- Collaboration and Partnerships: Stresses the importance of partnerships with various stakeholders to strengthen AI adoption and resource availability.

Together, these components aim to transform libraries into dynamic, responsive, and community-focused institutions in the digital age (Ajani et al., 2024; Ojobor et al., 2025).

**Table 3: Summary of Key Components of the Proposed Framework**

| Component | Description | Expected Outcomes |
|---|---|---|
| **Technological Integration** | Deployment of AI tools such as automated cataloguing, chatbots, recommender systems, virtual learning platforms, and predictive analytics. | Improved efficiency, personalized user services, enhanced access to digital resources, and data-driven decision-making. |
| **Human Capital Development** | Continuous training in AI literacy, data management, digital competencies, and emerging technologies for librarians and support staff. | Skilled workforce, improved service delivery, and increased organizational readiness for AI adoption. |
| **Policy and Governance** | Development of ethical AI guidelines, data protection policies, inclusivity standards, and strategic AI governance structures. | Responsible AI adoption, user trust, compliance with ethical standards, and sustainable innovation. |
| **Social Innovation Programs** | Initiatives that promote community engagement, digital literacy, research support, entrepreneurial learning, and innovation activities within the library. | Strengthened community impact, diversified library roles, and increased relevance in teaching, research, and social development. |
| **Collaboration and Partnerships** | Alliances with universities, tech firms, industries, research networks, and government bodies to support innovation and resource sharing. | Access to expertise, enhanced infrastructure, shared innovation ecosystems, and accelerated AI transformation. |

## Theoretical Implications

The suggested framework for redesigning libraries with AI combines Diffusion of Innovation (DOI) Theory and Socio-Technical Systems (STS) Theory to explain how AI is being used in libraries in Nigeria. DOI Theory describes the stages of adoption: knowledge, persuasion, decision, implementation, and confirmation. It also talks about factors like perceived usefulness and compatibility that help people get over their resistance and improve their training for technologies like chatbots and predictive analytics. At the same time, STS Theory stresses the importance of effective human interaction and organizational change, saying that the success of technology depends on the skills of librarians and the needs of the community. The combination of these theories gives us a full picture of how to integrate AI into libraries. It helps with research and strategic planning by making sure that ethical policies and community-engaged practices are in place, which leads to sustainable library services and new ideas.

## Policy Implications

- Policymakers must invest in AI infrastructure, digital literacy, and equitable access to ensure libraries serve as innovation hubs.

- Establish guidelines for ethical AI use, ensuring privacy, transparency, and social inclusivity.
- Invest in AI infrastructure and digital skills.
- Develop ethical, inclusive AI policies.
- Encourage partnerships and social innovation programs.

Table 4: **Key Themes, Findings, and References on AI Integration and Innovation in Nigerian Libraries (2019–2025)**

| Theme | Key Findings | References |
|---|---|---|
| **AI Adoption** | Nigerian libraries are increasingly deploying AI-driven technologies to enhance service delivery. Chatbots provide 24/7 virtual reference support, improving accessibility and user engagement. Predictive analytics optimizes collection development, resource allocation, and circulation planning, enabling data-driven decision-making. Intelligent cataloguing and metadata management automate classification, indexing, and retrieval, reducing errors and turnaround time. | Tella et al., 2025; Ojobor et al., 2025 |
| **Innovation Hubs** | Libraries are evolving into dynamic innovation hubs that support research collaboration, digital literacy programs, and community-driven projects. They are becoming central nodes in academic and social ecosystems, facilitating knowledge co-creation and enhancing societal engagement. | Ajani et al., 2024; Adigun et al., 2024; Idhalama, & Nwachukwu, 2025 |
| **Barriers** | Challenges include infrastructural deficits (hardware, software, internet connectivity), skill gaps among librarians in AI and data analytics, limited policy frameworks, and digital inequities. These factors hinder effective AI adoption and equitable access to services, potentially marginalizing some user groups. | Isiaka et al., 2024; Ubochi & Soroibe, 2024 |
| **Opportunities** | AI adoption presents opportunities to improve operational efficiency, personalize services, and strengthen social impact. Predictive planning and proactive service delivery enhance user experience, while strategic partnerships with universities, tech firms, and industries expand innovation capacity and AI literacy. | Okoye, 2024 |

## Conclusion

The systematic review indicates that Nigerian libraries are transitioning into the digital AI era, adopting technologies such as chatbots and predictive analytics to improve efficiency and service personalization. Libraries are evolving into innovation hubs, but challenges like inadequate infrastructure, limited AI literacy, and digital inequities hinder progress. Strategic partnerships and investments in professional development are essential to leverage AI capabilities fully. The review emphasizes the potential of these

libraries to become innovative entities that provide equitable access to information and drive knowledge advancement, highlighting the need for ongoing research and policy progression for sustainable digital transformation.

*Recommendations*

1. **Infrastructure:** Upgrade digital networks, servers, and AI-ready platforms.
2. **Human Capital:** Provide ongoing AI training for librarians.
3. **Policy:** Develop ethical AI, data privacy, and inclusivity frameworks.
4. **Social Innovation:** Implement programs addressing community needs, research support, and digital literacy.
5. **Partnerships:** Collaborate with universities, tech firms, and government agencies.

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