
INCLUSIVE E - LIBRARY SYSTEMS IN THE AGE OF ARTIFICIAL INTELLIGENCE: PROMOTING DIGITAL SKILLS AND SUSTAINABLE INNOVATION IN NORTH EAST OF NIGERIA

Case Study

Volume 1 | Issue 1 | 2026



Received: 30 May 2026

Accepted: 06 June 2026

Asenah Alexander Shalmalmi¹, Sale Sule², Reuben Benson³¹ Department of Library, Adamawa State College of Education, Hong, Nigeria² Department of Library, Adamawa State College of Education, Hong, Nigeria³ Curriculum and Instructional Technology, School of General Education, Adamawa State College of Education, Hong, Nigeria **RB**, [0000-0003-4484-3408](https://orcid.org/0000-0003-4484-3408)Correspondence: Asenah Alexander Shalmalmi, teyananya@gmail.com

Abstract

This study examined the role of inclusive e-library systems in promoting digital skills and sustainable innovation in tertiary institutions in North East of Nigeria. Specifically, it looked at the contributions of inclusive e-library systems toward digital skills development, identified challenges affecting AI-enabled e-library implementation, and determined strategies for promoting sustainable innovation through inclusive e-library systems. The integration of AI into electronic library systems has strengthened information accessibility, digital literacy development, and innovation capacity within higher education institutions. A descriptive survey research design was used. Lecturers, librarians, and students from particular postsecondary institutions made up the population. Using stratified random sampling methods, a sample size of 180 respondents was chosen. A systematic questionnaire called the Inclusive E-Library Systems and Sustainable Innovation Questionnaire (IELSSIQ) was used to gather data. For data analysis, the mean and standard deviation were used. The results showed that inclusive e-library systems greatly enhance information literacy, innovation capacity, and digital competencies. The main obstacles to adoption were found to be inadequate financing, inadequate AI literacy, and infrastructure deficiencies. To improve sustainable educational reform, the study suggests increasing institutional investment in AI-powered library infrastructure, ongoing programs for developing digital skills, and supportive policy frameworks.

Keywords: Artificial Intelligence, Inclusive E-Library Systems, Digital Skills, Sustainable Innovation, Digital Inclusion

Introduction

AI has become one of the most revolutionary technologies affecting knowledge sharing, information management, and education worldwide. Libraries are becoming intelligent digital ecosystems that can support teaching, learning, research, collaboration, and innovation instead of being traditional repositories of printed resources due to the rapid growth of technology (Holmes et al., 2019; Cox et al., 2019). Information accessibility and the provision of educational services have been revolutionized by artificial intelligence technologies such as machine learning, natural language processing, predictive analytics, recommendation systems, intelligent search mechanisms, automated indexing, and virtual assistants (Russell & Norvig, 2021).

Electronic libraries, also known as e-libraries, are digital information environments that use internet-enabled technologies to give users access to academic databases, books, journals, institutional repositories, and multimedia learning resources. Regardless of a person's handicap, geography, financial situation, or technological limitations, inclusive e-library systems are made to provide fair access to information resources (Pedro et al., 2019; UNESCO, 2021). Because fair information accessibility has a major impact on knowledge acquisition, educational participation, lifelong learning, and national development, educational inclusion is still crucial.

By enabling intelligent information retrieval systems, metadata creation, automated cataloguing, chatbots, speech recognition systems, and adaptive learning technologies, artificial intelligence technologies have further reinforced digital library ecosystems (Cox et al., 2019; Wang et al., 2021). AI-powered e-library systems use adaptive interfaces and tailored recommendations to improve resource discoverability and user experiences. The ability to participate effectively in modern educational environments now requires digital skills. Information literacy, digital communication, online collaboration, content production, data management, cyber safety awareness, and artificial intelligence literacy are all included in digital competencies (OECD, 2021; European Commission, 2022). Stronger instructional effectiveness and innovative performance are shown by institutions that can successfully incorporate AI technologies into their educational systems (Luckin et al., 2016).

In order to ensure equal resource accessibility and technical sustainability, sustainable innovation entails creating educational and technology systems that may produce long-term educational, economic, and societal advantages (United Nations, 2020). Infrastructure preparedness, personnel competency, technological capability, and institutional support mechanisms are all critical components of sustainable educational innovation (Jordan & Mitchell, 2015).

Even though AI is becoming more widely used worldwide, developing educational systems still face substantial implementation problems. Successful educational technology adoption is still hampered by a lack of infrastructure, inadequate institutional support, financial restrictions, digital inequalities, and workforce competency deficiencies (Ayanwale et al., 2025).

According to Reuben and Kabilan's (2024) assessment, university instructors in North-East Nigeria were moderately prepared to use AI technologies. According to their findings, AI adoption readiness was highly influenced by institutional support, digital competency, and technical knowledge. For AI integration to be successful, the researchers stressed the importance of ongoing professional development and infrastructural enhancement.

Lecturers' efficacy in implementing AI in educational settings is strongly influenced by their technological proficiency, pedagogical adaptability, and awareness of AI. Thus, AI-powered inclusive e-library systems are a crucial step in fostering sustainable educational innovation and enhancing digital competences.

Objectives of the Study

The study sought to:

1. Examine the contributions of inclusive e-library systems to digital skills development.
2. Identify challenges affecting AI-enabled inclusive e-library implementation.
3. Determine strategies for promoting sustainable innovation through inclusive e-library systems.

Research Questions

1. How do inclusive e-library systems contribute to digital skills development?
2. What challenges affect AI-enabled inclusive e-library implementation?
3. Which strategies enhance sustainable innovation through inclusive e-library systems?

Literature Review

Artificial Intelligence and Inclusive E-Library Systems

Through automated indexing, intelligent cataloguing, recommendation systems, virtual assistant technologies, and predictive information retrieval systems, artificial intelligence technologies are still revolutionizing library operations around the world (Russell & Norvig, 2021).

According to Holmes et al. (2019), artificial intelligence enhances educational customization by enabling flexible learning environments that can adapt to the unique learning demands of each student.

In a similar vein, Luckin et al. (2016) contended that artificial intelligence technologies enhance educational accessibility by means of intelligent tutoring systems, individualized instruction, and adaptive learning support.

According to Pedro et al. (2019), digital inclusion plays a major role in enhancing equitable educational participation and lowering information inequality.

Through tailored learning experiences and clever retrieval techniques, AI-powered library systems enhance resource discoverability, user engagement, and information accessibility (Wang et al., 2021).

Additionally, UNESCO (2021) emphasized that integrating AI enhances digital educational environments and advances fair educational possibilities.

Inclusive E-Library Systems and Digital Skills Development

In order to participate in education and be prepared for the workforce, digital competencies are becoming more and more important. According to OECD (2021), digital literacy, information management, online communication, cyber safety awareness, and AI literacy are essential skills needed in contemporary knowledge society.

According to the European Commission (2022), educational institutions that include AI technologies successfully enhance students' performance in terms of innovation and digital competency acquisition.

Reuben and Kabilan (2024) discovered that in North-East Nigeria, lecturers' preparedness to use AI is strongly influenced by technology knowledge, digital competence, and institutional support.

Similar findings were made by Ayanwale et al. (2025), who noted that labor readiness and infrastructure readiness had a major impact on the successful integration of educational technology. Therefore, promoting sustainable educational change and technological innovation continues to depend heavily on digital inclusion.

Sustainable Innovation and Artificial Intelligence Integration

Technological innovation that can produce long-term advantages for society, the economy, and education is referred to as sustainable innovation (United Nations, 2020). Artificial intelligence technologies, according to Jordan and Mitchell (2015), increase institutional sustainability through increased productivity, efficient automation, and efficient use of resources.

AI-supported digital transformation projects enhance institutional resilience and fortify innovation ecosystems, according to OECD (2021).

Reuben and Kabilan (2024) also noted that higher implementation success is shown by educational institutions that invest in professional development, infrastructure development, and AI competence training.

According to UNESCO (2021), institutional readiness and cooperative partnerships are essential components of sustained educational innovation.

Methodology

According to Creswell and Creswell (2018), the study used a descriptive survey research design. A sample size of 180 respondents was chosen using stratified random sampling procedures, and the population consisted of lecturers, librarians, and students from tertiary institutions in North East of Nigeria. A systematic questionnaire called the Inclusive E-Library Systems and Sustainable Innovation Questionnaire (IELSSIQ) was used to gather data. A four-point Likert scale—Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1)—was used in the test. To guarantee content relevancy and clarity, the questionnaire was validated by specialists in educational technology and library and information science. The mean and standard deviation were used to examine the data, and mean scores more than 2.50 were deemed acceptable.

Results and Data Analysis

Research Question One

Table 1: Contributions of Inclusive E-Library Systems to Digital Skills Development

S/ N	Item	Mean	SD	Decision
1	Inclusive e-library systems improve information literacy skills	3.62	0.61	Accepted
2	AI-enabled search technologies improve digital competencies	3.51	0.68	Accepted
3	Digital libraries improve collaboration abilities	3.39	0.72	Accepted
4	AI recommendation systems strengthen learning outcomes	3.48	0.70	Accepted
	Grand Mean	3.50	0.68	Accepted

Source: Field Survey, 2026

Table 1 above, indicates that inclusive e-library systems contribute significantly toward strengthening digital competencies.

Research Question Two

Table 2: Challenges Affecting AI-Enabled Inclusive E-Library Systems

S/ N	Item	Mean	SD	Decision
1	Poor infrastructure limits implementation effectiveness	3.68	0.55	Accepted
2	Insufficient AI literacy affects adoption	3.54	0.69	Accepted
3	Funding constraints affect sustainability	3.60	0.60	Accepted
4	Digital inequality limits accessibility	3.41	0.74	Accepted
	Grand Mean	3.56	0.65	Accepted

Source: Field Survey, 2026

Table 2 above, shown infrastructure deficits and workforce competency limitations remain major barriers.

Research Question Three

Table 3: Strategies for Sustainable Innovation

S/N	Item	Mean	SD	Decision
1	Continuous digital skills development programmes	3.74	0.54	Accepted
2	Institutional investment in AI infrastructure	3.69	0.58	Accepted
3	Policy support strengthens sustainability	3.61	0.63	Accepted
4	AI literacy awareness programmes improve implementation	3.65	0.59	Accepted
	Grand Mean	3.67	0.59	Accepted

Source: Field Survey, 2026

Table 3 above, indicates that institutional investment and digital capacity development strengthen sustainable innovation.

Findings of the Study

1. The study exposes that by enhancing information literacy, online research abilities, and general digital competence among lecturers, librarians, and students, inclusive e-library systems greatly improve the development of digital skills.
2. The study found that inadequate ICT infrastructure, low AI literacy, financial constraints, and digital inequality all impede the deployment of AI-enabled inclusive e-library systems.
3. The study establishes that ongoing training in digital skills, institutional investment in AI infrastructure, supportive policies, and AI literacy development programs can all foster sustainable innovation in inclusive e-library systems.

Discussion of Findings

The study's findings showed that inclusive e-library systems greatly improve students', lecturers', and librarians' development of digital abilities. Information literacy, online research abilities, and general digital competency are all enhanced by AI-enabled search tools, digital repositories, and recommendation systems, according to respondents. This result is consistent with the OECD's (2021) emphasis that learners' skills in information management, communication, and content production are strengthened by digital environments bolstered by evolving technology. In a similar vein, Holmes et al. (2019) Luckin et al. (2016), and Wang et al. (2021) noted that AI-driven educational systems enhance users' capacity to find, assess, and use digital knowledge efficiently.

The findings corroborate Reuben and Kabilan's (2024) findings that exposure to digital technologies and institutional assistance greatly improve lecturers' digital competence and readiness for AI adoption in Nigeria. The implication is that inclusive e-library systems function as training environments that promote

ongoing digital skill acquisition required for academic and professional development in addition to being platforms for information access.

The study discovered that a number of obstacles prevent AI-enabled inclusive e-library systems from being implemented successfully. These include poor ICT infrastructure, low user AI knowledge, financial limitations, and digital inequality. These difficulties imply that while institutions may see the value of AI in library systems, their ability to put such systems into place and maintain them is still constrained.

This result is in line with the findings of Ayanwale et al. (2025), who found that the efficacy of integrating AI in educational contexts is greatly diminished by infrastructure constraints and insufficient digital competences. Due to inadequate institutional support systems and few possibilities for professional growth, many higher education institutions in North-East Nigeria continue to function at modest levels of AI readiness, according to Reuben and Kabilan (2024). Additionally, UNESCO (2021) observed that equal access to AI-powered educational materials in developing places is still impacted by concerns related to the digital divide. The consequence is that inclusive AI-enabled e-library systems would not reach their full potential if infrastructure deficiencies and issues with digital literacy are not addressed.

The study's decisions showed that ongoing training in digital skills, increasing institutional investment in AI infrastructure, legislative support, and AI literacy development initiatives can all lead to sustainable innovation in inclusive e-library systems. Initiatives to increase capacity are crucial for optimizing the advantages of AI in library services, according to respondents. This result is consistent with the OECD's (2021) emphasis that ongoing investments in technology infrastructure and human capacity development are necessary for a sustainable digital transformation. In a similar vein, UNESCO (2021) emphasized that robust legislative frameworks, institutional dedication, and stakeholder cooperation are necessary for successful AI integration in education.

Reuben and Kabilan (2024) further confirmed that institutional assistance and professional training greatly improve academic staff members' readiness to use AI. The upshot is that human capacity development and institutional reforms led by policy are just as important for sustainable innovation as technological availability.

Overall, the study shows that AI-powered inclusive e-library systems are important for fostering sustainable innovation and improving the development of digital skills in higher education. However, budget limitations, inadequate infrastructure, and low AI literacy continue to be significant obstacles to successful adoption. AI-enabled e-library systems will realize their full potential in promoting educational reform if these obstacles are addressed through strategic investment, training, and governmental support.

Conclusion

Artificial intelligence-supported inclusive e-library systems offer significant chances to improve digital capabilities and sustainable innovation. Artificial intelligence technologies enhance instructional efficacy, institutional productivity, resource discoverability, and information accessibility. However, finance constraints, inadequate AI knowledge, and infrastructural deficiencies continue to be obstacles to deployment. For educational reform to be sustainable, institutional technology readiness and digital competency development must be strengthened.

Recommendations

The following recommendations were made based on the findings of the study:

1. Educational institutions should invest in AI-powered digital library infrastructure.
2. Continuous Artificial Intelligence literacy and digital competence development programmes should be strengthened.
3. Governments and educational institutions should reinforce digital inclusion policies.
4. Sustainable funding mechanisms should support AI-enabled library systems.
5. Institutional support structures should strengthen Artificial Intelligence implementation efficacy.

References

1. Ayanwale, M. A., Sanusi, I. T., Aruleba, K. D., & Oyelere, S. S. (2025). Artificial intelligence readiness among educators in developing educational systems. *Education and Information Technologies*, 30(2), 1451–1473.
2. Cox, A. M., Pinfield, S., & Rutter, S. (2019). The intelligent library: Thought leaders' views on Artificial Intelligence and academic libraries. *Library Hi Tech*, 37(3), 418–435.
3. Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative and mixed methods approaches* (5th ed.). Sage Publications.
4. European Commission. (2022). *Digital education action plan 2021–2027*. Brussels.
5. Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial Intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.
6. Jordan, M. I., & Mitchell, T. M. (2015). Machine learning: Trends, perspectives and prospects. *Science*, 349(6245), 255–260.
7. Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson.
8. OECD. (2021). *Digital education outlook 2021*. OECD Publishing.
9. Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). *Artificial intelligence in education: Challenges and opportunities for sustainable development*. UNESCO.
10. Reuben, B., & Kabilan, M. K. (2024). Assessment of University Lecturers' Readiness to Adopt Artificial Intelligence (AI) Technology in North-East of Nigeria. *International Journal of Advanced Research in Education and Society* e-ISSN: 2682-8138 | Vol. 6, No. 2, 482-490, 2024 <http://myjms.mohe.gov.my/index.php/ijares>
11. Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.

12. UNESCO. (2021). Artificial Intelligence and education: Guidance for policymakers. UNESCO.
 13. United Nations. (2020). Transforming our world: The 2030 agenda for sustainable development.
 14. Wang, P., Li, Y., & Zhao, H. (2021). Artificial Intelligence applications in academic libraries: Opportunities and challenges. *Journal of Academic Librarianship*, 47(4), 102–115.
-



© 2026 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by-nc-sa/4.0/>).