J Data Sci. Info. Citation Studies., 2026; 5(2):73-80.
https://www.jcitation.org

Review Article

Artificial Intelligence and Data Science in Academic Libraries: Framework, Competencies, and Adoption Challenges among Library Professionals

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ABSTRACT

The accelerating integration of Artificial Intelligence (AI) and data science into academic knowledge systems has created an urgent imperative for library professionals to reassess their competency frameworks, service models, and institutional readiness. Drawing conceptually on the International Federation of Library Associations and Institutions (IFLA) Big Data Special Interest Group framework and synthesising evidence from Q1-ranked, Elsevier, and Scopus-indexed publications (2018-2025), this paper examines the theoretical foundations and practical dimensions of AI and data science adoption in academic libraries. Three research questions guided the study: the level of AI and data science awareness among library professionals; the nature of data science services currently offered or feasibly deployable in academic libraries; and the key barriers to adopting AI-driven services. A conceptual-analytical research design was employed, integrating systematic literature synthesis with a structured competency mapping exercise. Findings reveal that while foundational data science awareness is growing, significant skills gaps persist- particularly in library analytics, text and data mining, and AI-driven patron services. A hypothesis is advanced that academic librarians' digital literacy competency levels are significantly and positively associated with their institutional readiness to adopt AI and data science frameworks. The paper concludes with a multi-dimensional adoption framework organised around three pillars: Skills, Operations, and Services, and proposes evidence-based recommendations for embedding data science into the professional DNA of librarianship.

Keywords: Academic Libraries, Artificial Intelligence, Big Data, Research Data Management, Data Literacy, Data Science, Digital Competency, IFLA Framework, Library Analytics, Text and Data Mining.

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Received: 16-04-2026;
Revised: 03-06-2026;
Accepted: 28-07-2026.

INTRODUCTION

The fourth industrial revolution has fundamentally reconfigured the information landscape in which academic libraries operate. Data- in its manifold forms, volumes, velocities, and varieties- has emerged as the primary economic and epistemic currency of contemporary knowledge production (IFLA Big Data Special Interest Group (IFLA BDSIG, 2018; Laney, 2001). Artificial Intelligence (AI) and data science, once confined to the domains of computer science and computational statistics, have now permeated virtually every academic discipline, transforming not only how knowledge is created and disseminated but also how it is organised, preserved, discovered, and reused (Corrall and Cox, 2022; Pinfield *et al*., 2022). In this context, academic libraries face a decisive inflection point: either proactively integrate AI and data science capacities into their professional identity and service portfolio, or risk marginalisation in an increasingly data-intensive research environment (Vieira *et al*., 2023).

The IFLA BDSIG (2018) conceptual framework for data science in libraries identifies a spectrum of data-related roles-ranging from data archivist and data curator to data analyst and data technologist- and argues persuasively that libraries must develop a culture of 'data savviness' at every level of professional practice (Lyon and Mattern, 2017). Yet empirical evidence consistently documents a persistent and widening gap between the aspirational positioning of libraries as data partners and the actual competency profiles of practicing library professionals (Cox *et al*., 2019; Federer, 2018). This gap is particularly acute in research libraries in developing economies, where infrastructure deficits compound the challenges of professional capacity development (Enakrire and Onuoha, 2024; Tella and Ayeni, 2024).

This paper contributes to the growing literature on AI and data science in Library and Information Science (LIS) by synthesising theoretical frameworks with empirical evidence drawn from

DOI: 10.5530/jcitation.20260001

high-impact, peer-reviewed sources. Three research questions are formulated, a hypothesis is advanced, and a structured conceptual framework is proposed to guide both professional development and institutional planning. The paper is organised as follows: Section 2 presents the statement of the problem; Section 3 formulates the research questions and hypothesis; Sections 4-6 constitute the literature review; Section 7 describes the research methodology; Sections 8-10 present the findings and discussion through three analytical tables; and the paper concludes with recommendations for practice and future research directions.

STATEMENT OF THE PROBLEM

Despite the growing prominence of AI and data science across academic disciplines, library and information science has been characterised by a reactive rather than proactive posture in its engagement with these technologies (Pinfield *et al.*, 2022; Showers, 2015). The IFLA BDSIG (2018) framework explicitly acknowledges that libraries are, on average, eight to ten years behind other industries in adopting data analytical methods for operational decision-making. This lag is not incidental; it reflects structural deficiencies in formal LIS education, a persistent absence of data science competency profiles within professional accreditation frameworks, and insufficient institutional investment in the specialist roles- such as data librarians and data technologists-needed to bridge the gap (Cox *et al.*, 2019; Federer, 2018).

The arrival of generative AI tools- including large language models such as GPT-4 and discipline-specific AI discovery platforms- has intensified these pressures while simultaneously opening new service possibilities that library professionals are often unprepared to leverage (Vieira *et al.*, 2023; Weidinger *et al.*, 2022). Patron privacy concerns, ethical challenges in AI-mediated information provision, text and data mining copyright barriers, and the absence of institutional data governance frameworks collectively compound the problem (Corrall and Cox, 2022; IFLA BDSIG, 2018). Without a coherent, evidence-informed strategy for AI and data science integration, academic libraries risk abdicating their role as facilitators of trusted, equitable knowledge access in a data-intensive world.

Research Questions and Hypothesis

The following research questions guided the study:

- What is the level of awareness and readiness of academic library professionals regarding artificial intelligence and data science frameworks, tools, and services?
- What data science services and competency domains are currently offered or feasibly deployable within academic library settings, and how do these map onto the IFLA Big Data SIG framework?
- What are the key organisational, infrastructural, ethical, and professional barriers to the adoption of AI and data science practices in academic library services?

Hypothesis

H_1: There is a significant positive relationship between academic librarians' digital literacy competency levels and their institutional readiness to adopt AI and data science frameworks in library services, such that higher digital literacy competency is associated with greater AI adoption readiness.

LITERATURE REVIEW

Data Science in Libraries: Conceptual Foundations

The conceptual terrain of data science in libraries was most comprehensively mapped by the IFLA Big Data Special Interest Group (2018), whose position paper articulated a multi-dimensional framework spanning three pillars: Skills, Operations, and Services. This framework represents a significant departure from the traditional bibliocentric identity of libraries, repositioning them as 'data-savvy' organisations capable not only of curating information artefacts but also of generating, analysing, and contextualising data to support institutional research missions (IFLA BDSIG, 2018; Cleveland, 2001). Lyon and Mattern (2017) empirically identified six distinct data science roles relevant to libraries- data archivist, data curator, data librarian, data analyst, data engineer, and data journalist- each demanding a distinct but overlapping competency profile. The authors argued that data librarians, in particular, are uniquely positioned to serve as interdisciplinary facilitators, translating between the technical vocabularies of research domains and the service language of librarianship.

Dononho (2015) traced the intellectual genealogy of data science from academic statistics, noting that the discipline's evolution from a mathematically intensive field to one encompassing software engineering, domain expertise, and data ethics created both opportunities and professional tensions for library practitioners. These tensions were captured by Cox *et al.* (2019) in their analysis of the 'credentialing tension' in library data roles- the contested boundary between stewardship-oriented data management activities and science-oriented data analysis tasks. Their findings, consistent with the IFLA BDSIG framework, suggested that practising librarians were far more comfortable with stewardship activities (such as research data management and institutional repository curation) than with science activities (such as statistical analysis, machine learning, or data mining). This distinction has significant implications for the design of continuing professional development programmes and the institutional structuring of data service teams.

Artificial Intelligence and Its Implications for Library Services

The penetration of AI into information services has been accelerating since the commercialisation of machine learning technologies in the mid-2010s (Vieira *et al*., 2023). In the library context, AI applications span a broad spectrum: from AI-powered discovery and recommendation systems (e.g., Ex Libris Primo, EBSCO Discovery Service) that leverage user behaviour data to personalise search results, to Natural Language Processing (NLP) tools capable of performing named-entity recognition on large collections of digitised texts for Digital Humanities projects (IFLA BDSIG, 2018; Corrall and Cox, 2022). The potential of AI to transform cataloguing through automated metadata generation, classification, and subject heading assignment has been demonstrated in several academic library settings (Pinfield *et al*., 2022; Weidinger *et al*., 2022).

However, alongside these opportunities, scholars have raised substantive ethical concerns. Weidinger *et al*. (2022), in a landmark paper published in the proceedings of FAccT 2022, systematically categorised the ethical and social risks of large language models, including disinformation generation, privacy violations through data inference, and the amplification of historical biases embedded in training datasets. These risks are particularly germane to library services, whose foundational values- privacy, equity, intellectual freedom, and impartial access-may be compromised by uncritical AI adoption (IFLA BDSIG, 2018; Corrall and Cox, 2022). The IFLA BDSIG (2018) framework emphasised that 'the values of privacy, ethics, and equitable access to information have always been core to libraries, uniquely positioning libraries to be new partners to researchers and sources of high-quality data'-a positioning that demands active engagement with AI ethics rather than passive adoption.

Research Data Management and Collections as Data

Research Data Management (RDM) constitutes one of the most mature and institutionally embedded dimensions of library data science practice (Pinfield *et al*., 2022). Cox *et al*. (2019) conducted a systematic survey of RDM service provision across 45 research-intensive universities and found that while RDM services had achieved considerable institutional penetration, the sophistication of these services varied enormously- from basic data management plan consultation to comprehensive data lifecycle management encompassing data creation, storage, analysis, sharing, and long-term preservation. The IFLA BDSIG (2018) framework identifies RDM as lying 'at the intersection of stewardship-oriented and science-oriented support roles', and articulates a range of RDM service types including advocacy, information services, and data repository management.

The 'collections as data' paradigm- which reframes library digital collections as computational datasets amenable to large-scale analysis- has emerged as a particularly innovative dimension of library data science services (Padilla *et al*., 2019). This paradigm builds on the recognition, articulated in the IFLA BDSIG (2018) framework, that libraries' curated digital collections constitute a form of 'long-tail big data' whose hidden scholarly value can be unlocked through text mining, computational analysis, and named-entity relationship extraction. Prominent initiatives such as the HathiTrust Digital Library, Google Books Ngram Viewer, and Culturomics' Bookworm project demonstrate the transformative potential of applying data mining techniques to large-scale digitised collections (IFLA BDSIG, 2018; Padilla *et al*., 2019).

Digital Literacy, Data Skills Gaps, and Professional Development

The concept of digital literacy- defined by JISC as 'the capabilities which fit an individual for living, learning and working in a digital society' and elaborated by Belshaw (2014) into eight essential elements (cultural, cognitive, constructive, communicative, confident, creative, critical, and civic)- provides the foundational competency framework within which data literacy and AI literacy must be situated (IFLA BDSIG, 2018; Ridsdale *et al*., 2015). Calzada Prado and Marzal (2013) proposed a comprehensive data literacy instruction framework built on five core modules: understanding data; finding and obtaining data; reading, interpreting, and evaluating data; managing data; and using data. This framework remains influential in contemporary LIS curricula design and continuing professional development programme construction (Federer, 2018; Cox *et al*., 2019).

Despite these frameworks, empirical studies consistently document significant data and digital literacy skills gaps among practising library professionals Federer (2018), in a study of data science competencies among biomedical librarians, found that while respondents expressed strong interest in developing data science skills, formal training opportunities were insufficient and unevenly distributed Cox *et al*. (2019) similarly reported that library practitioners in non-research-intensive institutions faced the greatest competency gaps precisely where the institutional need for data support was growing most rapidly. Training programmes such as Library Carpentry and Data Carpentry- modelled on The Carpentries' evidence-based approach to computational skills development- have emerged as important instruments for bridging these gaps at scale, yet their global reach remains uneven (Wilson, 2019; IFLA BDSIG, 2018). In the African context, Enakrire and Onuoha (2024) documented persistent technology-driven skills gaps among Nigerian university librarians, attributing these to insufficient professional development provision, technology infrastructure deficits, and weak integration of data science into LIS formal education programmes.

METHODOLOGY

This study adopted a conceptual-analytical research design, which is appropriate for synthesising theoretical frameworks and empirical evidence into a structured intellectual contribution where primary data collection is not the central objective (Grant and Booth, 2009; Jabareen, 2009). The design enabled a systematic mapping of AI and data science concepts, frameworks, and empirical findings onto the specific professional and institutional context of academic libraries, in line with the methodological tradition of conceptual papers in library and information science (Petticrew and Roberts, 2006).

Data were sourced through a structured literature search conducted across five major academic databases: Scopus, Web of Science, EBSCO Library, Information Science and Technology Abstracts (LISTA), and Google Scholar. The search protocol deployed Boolean operators combining the following key terms: 'artificial intelligence' OR 'AI' AND 'library'; 'data science' AND 'academic library'; 'library analytics'; 'research data management'; 'text and data mining'; and 'digital literacy' AND 'librarians'. Only peer-reviewed articles, institutional reports, and conference proceedings from Q1-ranked journals, Elsevier-published journals, Scopus-indexed sources, and IFLA official publications were included. Sources published between 2013 and 2025 were prioritised, with foundational theoretical works from earlier periods retained where conceptually indispensable (Cleveland, 2001; Laney, 2001; Calzada Prado and Marzal, 2013).

Content analysis of retrieved literature was performed thematically, organising findings into three analytical clusters aligned with the IFLA BDSIG (2018) framework pillars: Skills (Competency Domains and Training Provision), Operations (Library Analytics and Data Infrastructure), and Services (Research Data Management, Collections as Data, and AI-mediated Discovery). This thematic structure directly informed the construction of Tables 1-3, which synthesise the findings of the literature analysis into structured, actionable frameworks.

RESULTS AND DISCUSSION

Research Question 1: AI and Data Science Competency Framework for Academic Libraries

Research Question 1 examined the level of AI and data science awareness and readiness among library professionals by mapping core competency domains against library applications, skill levels, and available tools. Table 1 presents the resulting competency framework synthesised from the IFLA BDSIG (2018) framework, Cox *et al*. (2019), Federer (2018), and Calzada Prado and Marzal (2013).

The competency framework presented in Table 1 reveals six principal data science domains relevant to academic library practice. These domains span a continuum from foundational awareness (data ethics and privacy) through intermediate practice (data curation, data literacy instruction, library analytics, and AI awareness) to advanced specialisation (text and data mining). This hierarchical structure is consistent with the IFLA BDSIG (2018) articulation of a data-savviness spectrum, and with Cox *et al*.'s (2019) finding that stewardship-oriented competencies are more firmly established within library practice than science-oriented technical skills. The inclusion of an explicit 'AI awareness' domain-encompassing foundational through intermediate understanding of machine learning, NLP, and recommendation systems-reflects the growing recognition that practising librarians do not need to become data scientists but do need sufficient conceptual literacy to engage meaningfully with AI-mediated information environments (Vieira *et al*., 2023; Pinfield *et al*., 2022). This finding directly supports Hypothesis H1: librarians with stronger foundational digital literacy are better positioned to progress along the AI awareness continuum, consistent with the evidence from Federer (2018) and Enakrire and Onuoha (2024).

Research Question 2: Big Data Sources and Data Science Services in Academic Libraries

Research Question 2 examined the nature of data science services and competency domains feasibly deployable in academic libraries. Table 2 categorises big data sources relevant to academic libraries according to the four-class taxonomy proposed by the IFLA BDSIG (2018) and maps each class to specific library examples and use cases.

Table 2 demonstrates that academic libraries are already embedded within a rich ecology of big data sources, even if library professionals do not always recognise these sources as 'data' in the analytical sense. Archetypal data sources- including self-checkout logs, ILS transaction records, and discovery system activity logs- represent the most operationally immediate and analytically accessible class of library data, forming the natural foundation for entry-level library analytics programmes (IFLA BDSIG, 2018; Corrall and Cox, 2022). Crowd-sourced and sensor stream data present higher analytical complexity but offer compelling operational insights, particularly around patron behaviour, space utilisation, and service scheduling-insights that can directly inform the evidence-based management decisions that library directors increasingly require (Pinfield *et al*., 2022).

Long-tail scholarly data-encompassing institutional repositories, bibliographic databases, and DOI-registered research datasets represent the most intellectually ambitious dimension of library data science services, linking directly to the 'collections as data' paradigm championed by Padilla *et al*. (2019). The application of text mining, NLP, and named-entity recognition to these collections opens possibilities for Digital Humanities collaboration that position libraries as active intellectual partners in the research enterprise rather than passive facilitators of access (IFLA BDSIG, 2018). As the IFLA BDSIG (2018) framework notes, however, copyright restrictions imposed by commercial publishers on text and data mining activities represent a significant barrier to realising this potential, a point addressed directly in Table 3.

Research Question 3: Barriers to AI and Data Science Adoption in Academic Libraries

Research Question 3 examined the key barriers to AI and data science adoption in academic library services Table 3 synthesises six barrier categories identified across the reviewed literature, describing their nature, impact on adoption, and recommended mitigation strategies.

Table 3 reveals a multi-layered barrier landscape in which technical, professional, ethical, legal, and managerial challenges intersect to constrain AI and data science adoption. The skills gap barrier is perhaps the most extensively documented in the literature (Cox *et al*., 2019; Federer, 2018; Enakrire and Onuoha, 2024) and is directly implicated in the study's hypothesis: if higher digital literacy competency is significantly associated with greater AI adoption readiness, then closing the skills gap is not merely a professional development aspiration but a strategic organisational priority. Infrastructure deficits and funding constraints are particularly acute in research libraries in developing economies, including Nigerian academic libraries, where the gap between institutional AI aspirations and the technological reality of library operations is widest (Tella and Ayeni, 2024; Enakrire and Onuoha, 2024).

The copyright and TDM barriers documented in Table 3 represent a structural challenge that individual libraries cannot resolve unilaterally. Corrall and Cox (2022) and the IFLA BDSIG (2018) framework both advocate for libraries to take an active advocacy role in lobbying for national and international copyright exceptions for text and data mining, positioning this as a core dimension of libraries' broader commitment to equitable knowledge access. The data privacy and ethics barrier is particularly salient in the context of AI adoption, where the deployment of patron profiling and predictive analytics tools creates genuine tensions with library professional ethics (Weidinger *et al*., 2022; IFLA BDSIG, 2018). Institutional data ethics policies- developed with active librarian participation and grounded in frameworks such as the GDPR and the Nigerian Data Protection Regulation (NDPR)- are essential preconditions for ethically responsible AI adoption in library settings.

DISCUSSION

The hypothesis reveals that academic librarians' digital literacy competency levels are significantly and positively associated with their institutional readiness to adopt AI and data science frameworks- finds robust theoretical and empirical support across the reviewed literature Federer (2018) demonstrated that librarians with stronger foundational digital and data literacy skills were significantly more likely to engage in advanced data science activities such as research data management consultation and data analysis training. Similarly (Cox *et al*., 2019) found that institutions which had invested in structured digital literacy

Table 1: AI and Data Science Competency Framework for Academic Library Professionals.

Data Science Domain	Key Competencies	Library Application	Skill Level Required	Example Tools/ Platforms
Data Curation and Management	Metadata creation, data cleaning, DMP writing	Institutional repository management, RDM services	Intermediate	DSpace, DKAN, OpenDOAR
Data Literacy Instruction	Teaching data concepts, data citation, curriculum design	Embedded librarianship, research support workshops	Intermediate	Data Carpentry, Library Carpentry
Library Analytics	Statistical analysis, dashboarding, user behaviour analysis	Collection optimisation, learning analytics	Intermediate-Advanced	Alma Analytics, Google Analytics, Power BI
Artificial Intelligence (AI) Awareness	Understanding ML, NLP, recommendation systems	Patron profiling, discovery services, chatbot deployment	Foundational-Intermediate	ChatGPT API, Hugging Face, IBM Watson
Data Ethics and Privacy	Privacy law, GDPR, data governance, ethical citation	Policy development, copyright advisory services	Foundational	POPI Act, GDPR compliance frameworks
Text and Data Mining (TDM)	NLP, content mining, named-entity recognition	Digital humanities, collection-as-data projects	Advanced	ContentMine, NLTK, OpenMinTeD, WikiData

Note. Source: Adapted from IFLA Big Data Special Interest Group (2018); Cox *et al*. (2019); Calzada Prado and Marzal (2013); Federer (2018). Skill Level Required: Foundational = awareness-level understanding; Intermediate = practitioner-level proficiency; Advanced = specialist/expert-level capability.

Table 2: Classification of Big Data Sources in Academic Libraries with Examples and Use Cases.

Big Data Source Type	Key Characteristics	Examples in Library Context	Potential Library Use Cases
Archetypal	High volume; low variety; automated generation	Self-checkout logs, loan transactions, fine records, usage pattern logs from discovery systems	Patron analytics, operational dashboards, predictive demand modelling
Crowd-sourced	High variety; irregular velocity; short-lived value	Library social media channels (Facebook, Twitter/X), user ratings and reviews, recommendation threads	Crowdsensing user interests; social media analytics; community engagement measurement
Sensor Stream	High volume, velocity, variety, and value	Security camera footage, turnstile activity logs, building temperature control meters	Footfall analysis, space utilisation studies, optimal staffing schedules
Long-tail Scholarly	High volume and veracity; low velocity and variety	Institutional repositories (theses, datasets), bibliographic metadata (OCLC WorldCat), DOI-registered datasets (Crossref)	Text and data mining (TDM), Digital Humanities projects, named-entity recognition, cross-language discovery

Note. Source: Adapted from IFLA Big Data Special Interest Group (2018); Laney (2001); Padilla *et al.* (2019). Classification follows the IFLA four-class big data taxonomy: Archetypal, Crowd-sourced, Sensor Stream, and Long-tail Scholarly. V-characteristics framework (Volume, Velocity, Variety, Veracity, Value) adapted from Laney (2001) as extended by IBM and Gartner.

Table 3: Barriers to AI and Data Science Adoption in Academic Libraries: Description, Impact, and Mitigation Strategies.

Barrier Category	Description	Impact on AI/Data Science Adoption	Recommended Mitigation Strategy
Skills Gap	Insufficient data science and AI competency among library professionals	Training deficit; no structured digital literacy curriculum in LIS education	Embed data literacy into LIS curricula; adopt Library Carpentry/Data Carpentry programmes
Infrastructure Deficit	Inadequate ICT infrastructure and digital tools for implementing AI services	Inability to deploy analytics platforms, dashboards, or AI-powered discovery tools	Institutional investment in library technology; cloud-based analytics platforms
Data Privacy and Ethics	Concerns around patron privacy, data ownership, and ethical use of AI-generated insights	Reluctance to implement patron profiling or predictive analytics tools	Develop institutional data ethics policies; train librarians on GDPR/POPI compliance
Funding Constraints	Insufficient financial resources to procure AI tools and sustain data science programmes	Inability to hire specialist data roles (data librarians, data technologists)	Pursue TETFund and external grant funding; establish cost-sharing consortia
Institutional Resistance	Lack of management commitment and strategic vision for data-driven library services	Slow organisational culture change; absence of data governance frameworks	Leadership advocacy; demonstrate value through library analytics dashboards at Level 1-2
Copyright and TDM Barriers	Restrictive publisher licences preventing text and data mining on subscribed content	Researchers unable to mine scholarly articles; researchers forced into knowledge silos	Libraries should advocate for copyright exceptions and negotiate TDM clauses in licences

Note. Source: Synthesised from IFLA Big Data Special Interest Group (2018); Cox *et al.* (2019); Corrall and Cox (2022); Weidinger *et al.* (2022); Enakrire and Onuoha (2024); Vieira *et al.* (2023). Barrier categories are not mutually exclusive; multiple barriers may co-occur within a single institutional context.

development programmes for library staff reported higher levels of data service provision and greater institutional confidence in AI-adjacent service areas.

Calzada and Marzal (2013), whose data literacy instruction framework-spanning understanding, finding, interpreting, managing, and using data- provides a widely adopted operationalisation of the data literacy construct, argued that progression through these instructional modules builds cumulative competency that enables practitioners to engage with progressively more complex data environments. This cumulative competency model is consistent with the digital fluency continuum described in the IFLA BDSIG (2018) framework, which posits four developmental levels (access, skills, practice, and identity) through which library professionals progress as they acquire data-savvy capabilities. The hypothesis is therefore empirically plausible and theoretically grounded; its formal empirical testing, through survey instruments deployed across academic library populations, is identified as a priority direction for future research.

CONCLUSION

This paper has examined the intersection of artificial intelligence, data science, and academic library services through a conceptual-analytical framework informed by the IFLA BDSIG (2018) position paper and a systematic synthesis of Q1-ranked, Elsevier-published, and Scopus-indexed literature. The analysis confirms that academic libraries are not peripheral to the AI and data science revolution- they are, in fact, ideally positioned by their professional values, institutional relationships, and curatorial expertise to play a central role in facilitating trusted, equitable, and ethically grounded access to AI-mediated and data-intensive knowledge resources. However, realising this potential requires a sustained, strategic, and multi-dimensional response that addresses skills gaps, operational infrastructure deficits, ethical challenges, and institutional cultural inertia simultaneously.

The three-table analytical framework presented in this paper-mapping competency domains (Table 1), big data service typologies (Table 2), and adoption barriers and mitigations (Table 3)-provides a structured, actionable tool for library directors, LIS educators, and professional associations seeking to guide their institutions towards greater AI and data science integration. The hypothesis advanced- that digital literacy competency levels are significantly and positively associated with AI adoption readiness- provides a testable theoretical proposition that future empirical research should pursue through rigorous survey and mixed-methods designs.

RECOMMENDATIONS

Based on this study's findings, the following evidence-based recommendations are made:

Embedded Data Science and AI Literacy programmes into LIS Curricula

Library schools and professional accreditation bodies such as the Librarians' Registration Council of Nigeria (LRCN) and the Nigerian Library Association (NLA) should mandate the integration of data literacy, AI awareness, and research data management competencies into both pre-service LIS education and continuing professional development frameworks.

Adoption of Structured Data Carpentry Training Programmes

Academic libraries should formalise partnerships with Library Carpentry and Data Carpentry to provide modular, certificate-based training in data management, statistical analysis, Python/R programming, and open data practices for their professional staff at scale.

Establishment of Specialist Data Roles

Library directors should advocate with institutional leadership for the creation of dedicated data librarian and data technologist roles, as conceptualised in the IFLA BDSIG (2018) framework, to provide the specialised capacity needed to bridge stewardship-oriented and science-oriented data service requirements.

Development of Institutional AI and Data Ethics Policies

Academic libraries should develop and publicly articulate institutional AI and data ethics policies-grounded in the GDPR, the Nigerian Data Protection Regulation (NDPR), and relevant IFLA professional ethics standards- to govern the ethical use of patron data in AI-mediated services.

Development of Library Analytics Programmes Incrementally

Following the IFLA BDSIG (2018) four-level capability model, academic libraries should begin with Level 1 analytics (function-specific dashboards) and progressively build towards Level 3 (correlation studies demonstrating value) and Level 4 (predictive and learning analytics), matching capability development to institutional readiness.

Advocacy programmes for Text and Data Mining Copyright Exceptions

Library professional associations and individual academic libraries should actively engage in national and international advocacy campaigns for copyright exceptions for text and data mining, building on existing international precedents (e.g., the EU Copyright Directive, Article 4) to facilitate researcher access to scholarly datasets.

ABBREVIATIONS

AI: Artificial Intelligence; **IFLA:** International Federation of Library Associations and Institutions; **IFLA BDSIG:** IFLA Big Data Special Interest Group; **LIS:** Library and Information Science; **RDM:** Research Data Management; **TDM:** Text and Data Mining; **NLP:** Natural Language Processing; **ML:** Machine Learning; **DMP:** Data Management Plan; **LISTA:** Library, Information Science and Technology Abstracts; **LRCN:** Librarians' Registration Council of Nigeria; **NLA:**

Nigerian Library Association; **NDPR:** Nigerian Data Protection Regulation; **GDPR:** General Data Protection Regulation; **POPI Act:** Protection of Personal Information Act; **DOI:** Digital Object Identifier; **TETFund:** Tertiary Education Trust Fund.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

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Cite this article: Dada KSJ. Artificial Intelligence and Data Science in Academic Libraries: Framework, Competencies, and Adoption Challenges among Library Professionals. Journal of Data Science, Informetrics, and Citation Studies. 2026;5(2):73-80.