



“Next Gen Librarianship: Mastering AI and Data Science Roles”

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ABSTRACT

The swift adoption of Artificial Intelligence (AI) and Data Science is fundamentally redefining academic librarianship, moving it away from the stereotypical role of knowledge carrier to that of a competent partner in the field. This paper examines changes in major library activities driven by AI, including the automation of technical services such as cataloging and metadata creation, and the expansion of user engagement through increasingly complex personalization systems. This study explores new core competencies essential for librarians to succeed in this AI-rich environment, with a particular emphasis on the growing imperative of AI literacy and data analytics. It also critically considers the widespread constraints on effective uptake, including infrastructure shortfalls, limited budgets, and, importantly, the ethical terrain in which data privacy and algorithmic bias operate. Ultimately, the study outlines a strategic Ethical Framework for academic library leadership that highlights continuous skill development, including LIS curriculum transformation and stronger ethical mandates. This model, intended to "enable purposeful, sustainable, and effective adoption of AI," is thus about preserving the continued relevance and indispensable role that librarianship has in the era of Data Science.

Keywords: Artificial Intelligence, Librarianship, Data Science, Competencies, Ethical Frameworks.

1. Introduction to AI in Academic Libraries

The surge of digital technologies and artificial intelligence (AI) has significantly changed the dynamics of librarianship, restructuring roles, skills, and expectations for information specialists in modern library environments. This changing scenario, often called the transition from traditional custody to dynamic digital facilitation, is discussed by Thiruppathi (2024), who notes that librarians are sailing in the salsa of information plenty and growing user numbers. Central to this is the introduction of AI, which is redefining fundamental library routines, critical operations decisions, and user services. Ahmed (2024) argues that AI is not simply a technological improvement; it is a disruptive influence on professional identity, and the skills required must be incorporated into both human expertise and intelligent systems. Many studies focus on different operational uses of AI, such as automatic cataloging, metadata creation, predictive services, and personalized applications (Hasan et al., 2024; Mallikarjuna, 2024; Laxmanrao, 2023). Enis (2024) also demonstrated that intelligent library architectures supported by IoT, cloud computing, and big data afford responsive, efficient, user-centred services.

The rise of AI in libraries has been increasingly recognized globally, as evidenced by bibliometric and survey research. Studies in India indicate high awareness and positive attitude among LIS professionals, but gaps in skill levels, ethical issues, and infrastructure limits are prominent barriers (Kalbande et al., 2024; Subaveerapandiyan & Gozali, 2024). Baber et al. (2024) also found positive attitudes toward AI-based solutions, but noted issues related to privacy and preparedness. At the disciplinary level, the uptake of AI is uneven, with some disciplines, such as law and health sciences, being more engaged (Friesen et al., 2023). Broader debates highlight algorithmic bias, staff training, and the requirement for responsible person-centric AI adoption (Olowookere, 2023; Harper & Groth, 2015; Frederick, 2020). As data-driven inquiry informs scholarship practice, Federer (2018) characterizes data librarianship as an emerging specialty that requires additional skills in data curation, analysis, and the ethical stewardship of this knowledge. Together, these

studies point to a field in flux: increasingly defined by the demands of ongoing learning, technological literacy, and ethical responsibility if it is going to remain relevant within an AI-augmented information environment.

1.1 Need of the Study

The rapid adoption of AI, machine learning, and data-centred applications is changing the nature of librarianship and urges a reconsideration of professional roles, competencies, and service delivery methods. As Thiruppathi (2024) points out, librarians these days are forced to work in an age of information overload and changing user expectations. This change is gaining further momentum as AI automates lower-level activities, improving access to information and personalized services (Hasan et al., 2024; Mallikarjuna, 2024). Ahmed (2024) points out that this change requires librarians to develop new digital, analytical, and ethical competencies and to operate as innovative enablers rather than as repositories.

However, despite such advancements, skill, infrastructure, ethical know-how, and institutional readiness gaps remain major. Surveys conducted in India (Kalbande et al., 2024; Subaveerapandiyan & Gozali, 2024) indicate keen interest in implementing AI and also highlight limited training, inadequate funding, and concerns about privacy, transparency, and algorithmic bias. The emergence of smart libraries (in conjunction with IoT, cloud computing, and big data) underscores additional reasons why librarians need to act proactively. In an era of data-driven scholarship, competencies associated with data librarianship—including curation, metadata management, and research support—should be further developed (Federer, 2018; Frederick, 2020). Thus, what is urged is systematic research that investigates how AI changes librarianship, which skills are necessary, and how libraries can gear up for durable integration.

1.2 Scope of the Study

This paper aims to explore the adoption, impact, and challenges of AI in academic libraries, drawing on the global and Indian literature published between 2018 and 2024. It covers four major dimensions. AI Applications in Libraries: Automation, Metadata generation, Information retrieval, Smart library infrastructure, and AI-empowered services. Professional change: New professional workforce roles, skills, and skillsets for the 'next generation' of librarians. Perspectives and Preparedness: The views, preparedness, and institutional challenges to the adoption of AI by librarians. Ethical and Technical Issues: Data privacy, algorithmic fairness, transparency, and infrastructure issues.

1.3 Objectives of the Study

The primary objectives of this study, grounded in the reviewed literature, are as follows:

1. To investigate the adoption of AI, ML, and innovative technologies for academic libraries in cataloguing, information retrieval, user services, and digital resources.
2. To understand the changing roles, duties, and skills of librarians in the AI-driven digital age, particularly how to shift from archivist-type librarianship to an intelligent collaborator.
3. To investigate LIS professionals' opinions, attitudes, and preparedness regarding AI implementation in academic libraries, with a specific focus on India.
4. To understand barriers, limitations, and ethical issues in integrating AI technologies into academic libraries with a focus on skill gaps, infrastructure investment, and cost, resistance to change, data privacy concerns, transparency and fairness, transparent decision-making processes, and incorporating values of a fairer society through responsible AI governance.
5. To investigate the new demand for data librarianship and develop a strategy framework or competency model that can support sustainable, ethical, future-ready AI applications in academic libraries.

2. Earlier Studies:

Thiruppathi (2024) examines digitization and its impact on librarianship, underscoring how librarians, as print collection custodians, are evolving into digital resource providers and instructors. The paper highlights next-generation roles—such as information curators, technology specialists, and digital educators—as well as issues including the information deluge, user expectations, and data privacy. With case studies and examples, it demonstrates best practices such as digital curation and embedded librarianship. Thiruppathi argues that librarians need to keep learning, innovating, and collaborating to remain relevant and practical in the age of information abundance. **Ahmed (2024)** inquiries into how the Library and Librarianship profession is redefining itself in the AI age, emphasizing that librarians are transforming from keepers to architects of knowledge and ethical advocates. The article describes how AI is fundamentally transforming cataloguing, reference services, metadata creation, and research support, even as it raises questions about privacy, bias, and professional identity. AI, Ahmed says, complements rather than substitutes for librarians, releasing them from the drudgery of routine computational work so they can attend to more nuanced human affairs, such as information literacy and ethical oversight. The paper suggests that ongoing education, ethical understanding, and flexible leadership are required from librarians working in environments increasingly dominated by AI. **Enis (2024)** explores generative Artificial Intelligence (AI)—including ChatGPT and other large language

models—in its role in revolutionizing library operations, engaging users, and confronting ethical considerations. The article underlines the dual role of librarians as educators and ethical intermediaries, navigating patrons in their use of AI to seek data transparency and academic integrity. Enis focuses on the increasing institutional adoption, arguing that AI implementation in cataloguing, reference, and information literacy seems inevitable. It is just that today we have to appreciate the balance between enthusiasm and vigilance when cultivating digital literacy and availability—in order to strategize for library survival—as AI creates new playgrounds. **Mallikarjuna (2024)** provides an analytical review of AI adoption in academic libraries, focusing on the implementation of machine learning, predictive analytics, and chatbots. The report describes the scientific and technical aspects of AI applied to automatic metadata generation, personalization services, and data-driven decision-making. It also highlights challenges related to ethics, data privacy, and staff training. The paper underscores that effective AI adoption requires successful planning and thoughtful stewardship, with a focus on human–AI collaboration and lifelong learning. The author argues that AI has the potential to turn academic libraries into effective, diverse, and user-friendly digital ecosystems. **Kalbande et al. (2024)** analyze the attitudes of Indian LIS professionals towards AI adoption in academic libraries. The paper reports on responses from 259 participants to a quantitative survey and provides an analysis indicating overall positive attitudes towards AI's potential to improve library services, efficiency, and access. Respondents were amenable to using AI tools and perceived its value for bridging the performance gap, along with reported challenges of finance, ethics, and skill paucity. The authors stress the need for training and a code of ethics for ensuring sustainable AI implementation in Indian libraries. **Subaveerapandian and Gozali (2024)** studied perceptions of Indian librarians regarding AI in libraries, collecting 386 responses. The findings show high awareness and favourable sentiment regarding AI's potential to improve efficiency, reach, and decision-making. Attendees stress that AI is meant to augment, rather than replace, human intelligence and that ethics -- including privacy, transparency, and bias prevention -- should be deeply considered as part of these solutions. The significant challenges identified are funding, technical know-how, and institutional preparation. Restrictions and Future Investigations. The findings of the investigation also suggest that AI use in Indian libraries appears promising, provided appropriate training, ethical guidelines, and managerial support.

In this study by **Baber et al. (2024)**, which considers the paradigm shift AI is bringing to modern libraries and focuses on AI-powered solutions for information management and user services. Based on survey responses from 91 library professionals in Islamabad, the results confirm the AI's potential to increase operational efficiency, particularly through tools such as chatbots and predictive analytics. The study highlights that libraries need to establish an inclusive environment where AI and library services coexist, preserving library relevance in the digital era while protecting user privacy. This position paper by **Hasan, Saifullah, and Hashmi (2024)** provides a survey of the revolutionary use of Artificial Intelligence (AI) in libraries and information centres. The writers examine how some of the core behaviours and practices in libraries, including reference services, cataloguing, and circulation—among others— are being improved using ML methodologies and Large Language Models. Critically, the review fairly weighs AI's benefits against its "downsides" and obstacles—a primer for novices interested in today's AI's effect on libraries and its future. Artificial intelligence from concept to classroom: A thematic analysis of the portrayals of AI in subject-specific library journals (law, health sciences, business and humanities/social sciences) Friesen, Tanna; Roy-Arnott, Alexissen Background The pace at which artificial intelligence (AI) has permeated this past decade through all facets of everyday life including libraries specifically can be best characterized as swift. The researchers examined 139 papers and found that discussion of AI is significantly more widespread among legal-specific information professionals. However, publication activity has increased across all disciplines over the past 10 years. This study offers a consolidated view of how AI affects liaison and subject librarian roles, rather than library-wide general implications. Artificial Intelligence, Libraries **Olowookere, D. T. (2023)**. The impact of artificial intelligence and machine learning on libraries in the 21st century: A perspective study on libraries' revolution and transformation. Artificial Intelligence Revolution and Transformation in Libraries (Impact on the Library). Both the positive impacts—such as automation, personalization, and predictive analytics—and the negative impacts of the same on libraries and librarians (ethical challenges, algorithmic bias, and digitally inferior-skilled librarians) are described in this paper. It underscores the importance of AI literacy, data ethics, and human oversight to guarantee responsible technological deployment. On the whole, the article portrays AI as an agent of change for library services and advocates for balanced adoption strategies that would protect inclusion and professional engagement in the digital age.

Laxmanrao's (2023) extensive article, "Role of Artificial Intelligence in Modern Libraries," offers a wealth of information on adopting artificial intelligence, including actionable data and service responses. The work well demonstrates various dimensions of AI's advantages by automating cataloging, using NLP-based information retrieval, and providing chatbot-based, personalized 24/7 user support. Laxmanrao, however, offers an equally critical perspective on the above-mentioned advantages and raises implications such as high implementation costs, a skills gap in technology and ethics related to data privacy, and algorithmic bias. The findings suggest that libraries should use AI strategically and responsibly to maintain their accessibility and effectiveness in an increasingly digital environment. **Harper and Groth (2021)** investigate the changing interplay between librarianship and AI, and its implications for developing the technical, analytical, and

ethical competencies of library professionals. They contend that AI integration requires entirely new competencies in areas such as data literacy, algorithmic transparency, and cross-disciplinary teamwork. The paper discusses librarians as resource brokers in addressing a fair and explainable use of AI in information systems. In examining professional adaptation and value reconstruction, the authors suggest that librarians will need to move from traditional gatekeepers of knowledge to strategic partners in AI environments, working alongside machines and combining human judgment with computational intelligence. **Frederick (2020)** considers the transformation of librarianship in an age when both artificial intelligence and "big data" have expanded. This article focuses on the significance of leadership, expertise, and responsiveness in describing how libraries' technological changes are reshaping their profession. Frederick stresses that librarians need to focus on core skills as they currently stand, with AI expertise, data stewardship, and ethical information treatment overlaid on top. The essay also highlights the growing importance of advocacy and partnerships as libraries navigate the digital and data-driven worlds. In the end, Frederick believes that librarians are the essential human intermediaries between human judgments and AI-driven systems—precisely what will keep libraries viable in this era of information.

Federer (2018) delves into the rise of data librarianship and its core competencies, skills, and training needs for individuals overseeing research data. Based on a survey of data librarians, the paper introduces two leading roles — data generalist and subject specialist — each with distinct competencies. Results: Communicative and relation-building abilities trump traditional cataloguing or collecting skills. The article highlights lifelong learning, organizational affinities/supports (or lack thereof), and curriculum changes to prepare librarians for contemporary data-oriented situations. In Federer's words, "Data librarian-hood is the gap between old library management and very new age open science". **Federer (2018)** considers the evolving field of data librarianship, highlighting bias in information science education and training that supports data-driven research. The study identifies skills such as data curation, metadata management, data visualization, and statistical analysis based on a professional survey. It demonstrates the multidisciplinary character of data librarianship, merging more traditional information management with computational and research support. They highlight the ongoing need for professional development and institutional investment to sustain the future uptake of data science in higher education. In his eyes, data librarians are also crucial for advancing open science and reproducible research.

3. Methodology and conceptual framework:

Methodology

A qualitative research design will be utilized in the present study, based on an analysis of scholarly literature published between 2018 and 2024. A review of peer-reviewed journal articles, conference papers, and professional reports on AI, ML, smart libraries, and data librarianship was conducted. The review also concentrated on sources that address AI applications in library operations (Hasan et al., 2024; Mallikarjuna, 2024), clever library building design incorporating IoT, cloud, big data technologies (Enis, 2024), changing professional positions (Ahmed, 2024; Thirupathi, 2024), ethical challenges (Olowookere, 2023), and new proficiencies necessary for data-oriented librarianship (Federer, 2018; Frederick, 2020).

A thematic content analysis method was utilized to thematically sort available research articles into four main themes: (1) AI applications and digital transformation in libraries, (2) changing roles and skills of librarians, (3) perceptions on the readiness towards adopting AI, and (4) ethical, infrastructure, and organizational challenges. Results from India-focused studies (Kalbande et al., 2024; Subaveerapandiyan & Gozali, 2024; Baber et al., 2024) were included to understand the regional context and challenges. This approach helped develop a more complete, evidence-based view of how AI is transforming librarianship and what it will take to achieve sustainable integration.

Conceptual Framework:

The constructs of AI integration, professional workforce transformation, and ethical–organizational readiness in academic libraries shape the theoretical model of this research. The emerging librarian: At the heart of the spectrum, we find the changing role of the librarian, no longer just an information custodian but a digital-savvy partner with AI systems. AI-Driven Library Operations – AI/ML-based tools improve cataloguing, metadata creation, information access, user management, and predictive analysis and workflow automation. Smart library infrastructure, including IoT, cloud computing, and big data, provides the technical foundation for a smart library. Professional Competencies and Readiness—Librarians need to learn new competencies, including AI literacy, digital curation, data analytics, coding basics, and the ethical assessment of automated systems. Research has revealed varying levels of preparedness and an optimistic yet self-restraining image among LIS. Ethical and Organizational Considerations – There is a need to address data privacy, algorithmic bias, transparency, intellectual property issues, and the maturity of infrastructure support for AI adoption. It is this three-fold framework that will help us understand how technological progress, human capabilities, and ethical–institutional governance shape the responsible and effective adoption of AI in academic libraries.

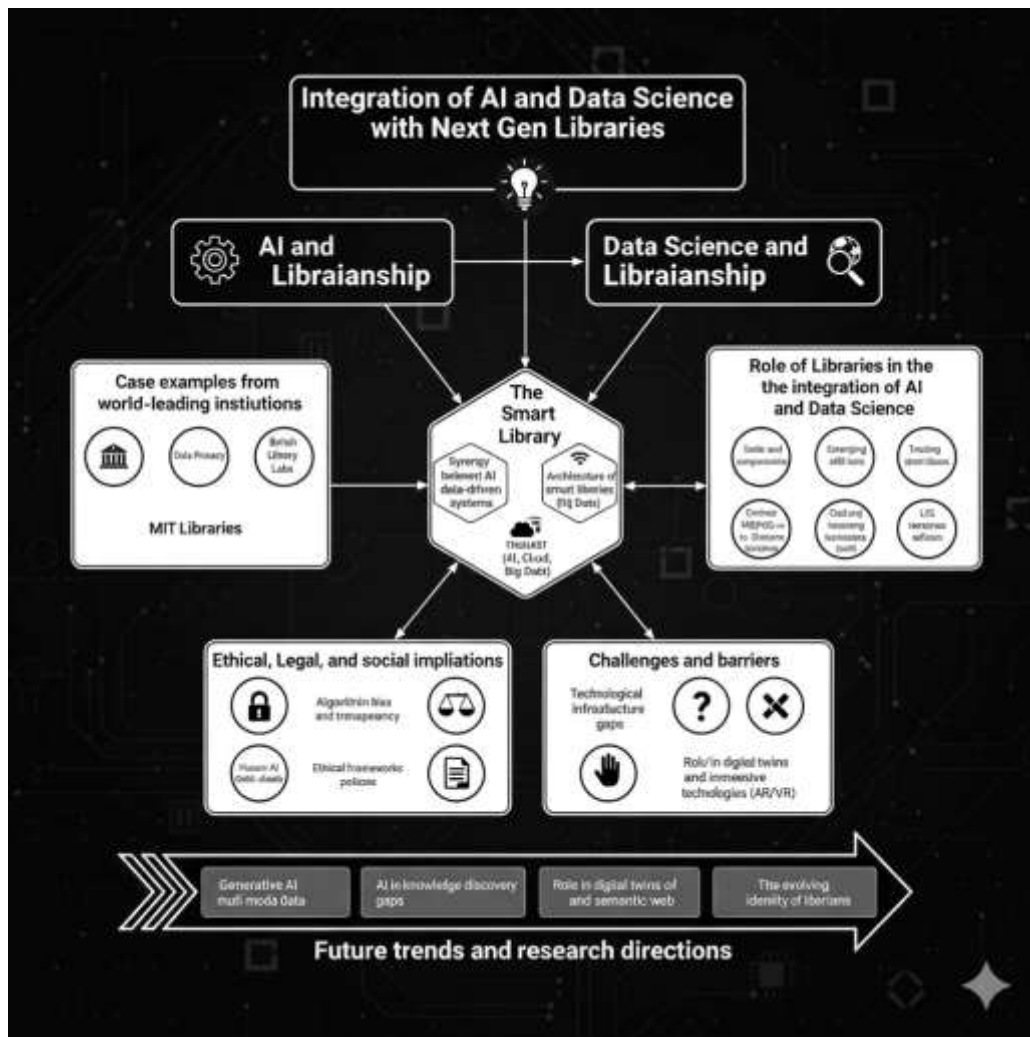


Figure 1: Conceptual framework of integration of AI and Data Science with Next Gen Libraries. [15]

4. AI and Librarianship

Artificial Intelligence (AI) is reshaping librarianship, transforming how information is managed and enabling new levels of user service and operational productivity. AI & Machine Learning (ML) in Libraries. The AI and ML divide into three major sub-domains: library Services and Operations, the Profession and Ethics; each of these will be covered, so far as possible. In user services, chatbots and recommendation systems are used to supercharge the patron experience with individualized assistance and immediate answers to frequently asked questions. AI is improving search by better understanding natural language queries. In operations, AI is now being used in fundamental technical roles to automate functions such as cataloguing, acquisition, and indexing, as well as metadata generation — all of which are likely to enhance efficiency and collection management.

The professional function of the librarian is changing to one in which they need to support patrons in using nascent generative AI tools such as ChatGPT. The new position will focus on information literacy and on timely assistance with engineering skills acquisition for patrons.

However, despite AI's benefits, its implementation also poses significant challenges. These include staff training and retraining to address workforce skills gaps and budget constraints, as well as data quality management. Then there are ethical considerations, including data privacy, algorithmic bias, transparency, and the possibility that AI could eventually supplant human intelligence. There are positive attitudes, with caution, among LIS professionals toward adopting AI.

5. Data Science and Librarianship

The intersection of data science and librarianship signals an evolutionary moment in the provision of information services. As libraries move away from traditional collections toward data-rich learning environments, librarians are taking on new roles as data stewards, educators, and partners in open science. According to Federer et al. (2020), core competencies for modern librarians are data literacy, service development, lifecycle management, research ethics, and training as defined by the Medical Library Association's Data Services Competency. Such skills allow librarians to collaboratively support data curation, visualization, and analysis as well as to maintain ethical standards and research integrity.

Data librarianship is more than just technical skills; it includes interdisciplinarity and user empowerment. Today, duties include metadata creation, data sharing, reproducibility assistance, and coding – mirroring a shift that has forced overlap between traditional library science and modern data science. With the growing centrality of data in scholarly communication, there are new ethical considerations for how libraries can guide researchers through data ethics and open-access mandates, including the FAIR (Findable, Accessible, Interoperable, Reusable) data principles.

Additionally, librarians play an educational role in data literacy by assisting patrons and researchers in critically engaging with datasets, algorithms, and digital infrastructures. They help convert raw data into usable intelligence, bringing computational methods into conversation with humanistic fields. This assimilation requires ongoing education and resources to remain relevant in a fast-paced technological environment.

In the end, data science reframes librarianship as a practice of applied rigor and ethical restraint. When libraries are working in harmony with data-driven scholarship and open science outreach, librarians remain vital participants in knowledge generation, striving to promote information ecosystems that are open, fair, egalitarian, and collaborative long into the digital age.

6. Integration of AI and Data Science: The innovative library model

The intelligent library model is a new type of intelligent equipment that, through the application of AI, data science, IoT, and cloud computing, automatically "humanizes" the user-oriented library space. AI enhances cataloguing, searching, and personalisation, and data analytics bolsters predictions and decisions. Innovative architectures enable automation, optimise resource consumption, and adapt services without manual intervention. This interoperability makes libraries dynamic digital environments that improve efficiency, discovery, and user experience.

6.1. Synergy of AI with Data-Driven Systems

The library becomes an intelligent, optimised, and predictive space through the assembly of AI together with data-powered systems. AI tools automate cataloging, enhance information retrieval precision, and provide personalized services. A data-driven culture enables informed decision-making and efficient resource use. Moreover, innovative infrastructure, incorporating AI, cloud, and IoT capabilities, further complements this synergy by offering automated workflow tracking and real-time, dedicated insights. This integration converts the libraries into another library and adapts them to form a flexible, responsive knowledge ecosystem.

6.2. Smart Library and Architecture (IoT, AI, Cloud, and Big Data)

The architectural structure of a smart library is formed by IoT end devices, AI systems, cloud platforms, and big data processing, which provides an atmosphere with automation, convenience, and user-centered service. The IoT generates tracking and bright spaces; AI supports cataloguing, discovery, and personalised services; cloud platforms provide scalable digital tools; and big data provides predictive insights for decision-making. Together, these mechanisms turn libraries into intelligent, adaptive information organisms.

7. Role of Libraries in the Integration of AI and Data Science

Libraries play a vital role in integrating AI and Data Science by providing digital resources, fostering data literacy, enabling intelligent information services, supporting research through advanced tools, and creating collaborative learning environments that prepare users for emerging technological advancements and smart knowledge ecosystems.

7.1. Skills and competencies for Next-Gen Librarians

Next-generation librarians require advanced skills in AI literacy, data analytics, digital curation, and technology-enhanced service delivery. They must understand AI tools, metadata automation, and innovative library systems to support modern information environments. Interpersonal and analytical skills remain essential for data stewardship and user support. As roles shift toward intelligent collaboration, librarians need continuous learning, ethical awareness, and adaptability to emerging digital ecosystems.

7.2. Emerging Skill Sets: AI Literacy, Data Analytics, Coding Basics, Digital Curation, and UX Design

Next-generation librarians must develop emerging skill sets to thrive in AI-enabled information environments. AI literacy, data analytics, and basic coding skills are essential for understanding automated systems and supporting innovative library services. Digital curation and UX design strengthen resource management and user-centered service delivery. The increasing emphasis on data-driven decision-making further underscores the need for strong competencies in data stewardship and analysis.

7.3. Training, MOOCs, and Certification Opportunities for LIS Professionals

Training, MOOCs, and certification programs are vital for equipping LIS professionals with AI, data analytics, and digital service competencies. Continuous learning is necessary to address skill gaps and support AI-driven library environments. MOOCs and online certifications offer flexible pathways for developing technical and data-related expertise. As innovative technologies expand, structured training initiatives become crucial for professional readiness and effective AI integration.

7.4. Role of LIS Curriculum Reform and Continuous Education Programmes (CEPs)

LIS curriculum reform is essential to prepare future librarians for AI-driven and data-intensive environments. Integrating AI literacy, data analytics, digital curation, and innovative technology competencies into academic programs is vital for developing future-ready professionals. Continuous Education Programmes (CEPs) support practicing librarians by updating skills and addressing technological disruptions. As libraries adopt AI, revised curricula and CEPs ensure sustained professional readiness and the ethical, effective integration of intelligent systems.

8. Ethical, Legal, and Social Implications

AI-mediated analytics inevitably leverage end-user data to an extent that challenges privacy, consent, and safekeeping of data in libraries. The need for a minder on patron privacy becomes critical when intelligent systems monitor behaviour and automated decision-making is embedded in both physical and virtual operations. Intellectual property considerations also arise in relation to AI-generated content and the automatic processing of digital resources, necessitating clarity on ownership and fair use. Librarians are responsible for ethical, legal, and transparent practices in their data work.

8.1. Algorithmic bias and transparency

AI is prone to bias, which can negatively affect library systems when the underlying dataset is flawed or fails to represent a particular group/individual. It is important for user trust and intellectual fairness that we have a transparent understanding of how AI tools classify, rank, or filter information. Librarians need to understand AI decision-making processes and make the case for ethical, explainable systems. Transparent communication and accountability enhance the equitable, responsible implementation of AI in libraries.

8.2. Human (AI) collaboration in information work

Human–AI collaboration can improve information work by combining AI's speed with librarians' judgment. AI also automates some tasks (cataloguing, metadata creation, basic questions), freeing librarians to concentrate on more complex reference, user engagement, and ethical oversight. Research indicates that librarians see AI as augmenting how they work—not replacing them—by helping most in decision-making, data stewardship, and personalised services.

8.3. Ethical toolkits and policies for library AI implementation

Ethical guidelines and policies are needed to introduce AI in libraries responsibly. Critical areas of focus include protecting user privacy, ensuring fairness in automated systems, and promoting transparency in AI decision-making. Intellectual property, data governance, and accountability must be addressed by policy as AI is woven into smart library infrastructures. Librarians can be integral allies in ethical advocacy and equitable AI implementation.

9. Challenges and Barriers

Several challenges inhibit libraries from using AI, such as a lack of technical architecture, high cost of implementation, and staff unpreparedness. AI tools remain a black box for most LIS professionals due to a lack of expertise and fear of job loss. Ethical issues around data privacy, algorithmic bias, and opacity make deployment even more complex. This involves ongoing learning and solid institutional support.

9.1. Technological Infrastructure Gaps

A lack of sufficient technology in the library often results in insufficient technology for proper AI implementation. Slow broadband connections, outdated hardware, and a lack of cloud-based solutions are preventing the adoption of intelligent systems. These discrepancies are even more marked in low-income regions, where financial constraints inhibit uptake. Libraries will not be able to fully leverage AI-powered

services, analytics, and automation without a robust digital infrastructure, hindering their efforts to create innovative library environments.

9.2. Unawareness or resistance to doing things in a better way

One significant obstacle to preaching about AI and libraries is the lack of knowledge amongst library staff on new technologies and their potential. Contemporary librarians are often hesitant or afraid to implement AI, driven by misunderstandings, skill deficits, and fear of job displacement. A lack of familiarity with automation and analytics technology exacerbates aversion to change. This challenge can be addressed through training programs, awareness creation, and strong institutional support.

9.3. Skill and Resource Limitations

Libraries are often lacking the capabilities and resources needed to achieve productive use of AI. "The skill set is not data analytics or coding, it is relating to your community and doing good work for them," she said. "We need the infrastructure in place so that when we actually have an opening for a librarian trained in these things, we can hire. Librarians often lack training in technology skills such as data analytics and AI literacy, leading to job vacancies. Resource constraints—namely, small budgets, underdeveloped digital capabilities, and poor access to sophisticated software—further constrain adoption. Such limitations inhibit the development of innovative library services and underscore the need for focused training and institutional support.

9.4. Sustainability and Funding Concerns

AI- and smart-based library technologies require long-term investment, but few institutions have yet figured out how to make that happen. High infrastructure, software (no off-the-shelf solution can provide OHVS), maintenance, and staff upscaling costs are significant obstacles. A small budget in developing places even discourages sustainable application. Moreover, without stable funding, libraries struggle to upgrade systems, renew licenses, and provide ongoing training to rate AI over the liner more fully.

10. Future Trends and Research Directions

Future development of library AI towards future, what is expected for library AI should be intelligent, personalized service system; predictive analysis and forecasting research are combined with people served as the core in a targeted way, and intelligent systems should deeply integrate IoT hardware devices, data cloud deep learning computing capabilities as well as artificial intelligence technologies into an overall integrated sorcerer's stone like solution to construct a complete intelligent campus library ecosystem. Studies will focus on ethical AI, data governance, and the impact of automation on librarians' roles. There is also a need to develop AI-enhanced subject services, user behaviour analysis, and more advanced digital capabilities.

10.1. Generative AI and LIS Applications involving Multimodal Data

OpenAI and multimodal Data resources are fundamentally reshaping LIS advancements by enabling automation through content creation, improved discovery, and user-centric services, both as human value-adders to society and individuals. These include summarization, metadata creation, image and text analysis, and personalization. Multimodal systems comprising text, audio, and video data are the backbone of smart library functionality in an IoT-based cloud environment. Librarians also need to cultivate new skills to manage and responsibly apply these evolving technologies.

10.2. Artificial Intelligence and Knowledge Discovery as well as Semantic Web Integration

" Artificial intelligence greatly increases the efficacy of knowledge discovery with automatic indexing, semantic search, and intelligent linking of content across various digital collections. With the weapons of Semantic Web technologies, there is an insightful quantum leap toward ontology-driven AI and knowledge graphs, significantly augmenting precision in retrieving information and context. These services enable librarians to deliver more profound, interconnected discovery experiences and help drive advanced research workflows.

10.3. Role of Digital Twins & Immersive Technologies (AR/VR)

Digital twins, along with advanced immersive technologies such as AR/VR, are becoming game changers in libraries, enabling virtual simulations of physical spaces and supporting teaching and learning, deeply engaging users. AR/VR can be applied to advanced information visualization, virtual tours, and experiential learning in an innovative library ecosystem. Librarians must also be equipped to work with these new technologies that complement AI-driven services and to gain the digital skills necessary to curate immersive content that guides users in their practical use.

10.4. Librarians as Data Scientists, Analysts, and Educators: A New Era of Evolution for the Information Professional Identity

Librarians are increasingly becoming data scientists, analysts, and teachers as AI and data-driven systems change how information services are offered. Instead, they must process data workflows, decipher analytics reports, and sustain digital scholarship. They require expertise in metadata modelling, knowledge organization, and user training. This wide-ranging identity has made librarians a direct enabler of digital literacy and critical inquiry in smart libraries.

11. Conclusion

The introduction of AI represents a fundamental paradigm shift in Library and Information Science (LIS); the role of the professional will shift from "knowledge keeper" to "intelligent collaborator." The literature supports the importance of intense attention and a positive attitude toward AI's value in personalizing services and automating workflows, with success depending on proactive handling of several telltale signs. Top concerns -- such as data privacy, risks of algorithmic bias, and, critically, how to equip and train all staff with AI literacy and data analytics training amid a global skills crisis. For the future, LIS professionals need to develop an innovation mindset and continuously upskill their professional competence in prompt engineering and data science, facilitated by a broad curricular reform. In the end, it will be librarians who must choose to be front-and-center hubs of AI competence—through example-setting, ethical framing, and guidance— as indispensable copilots of the era of intelligent information, where AI will work best when not a substitute for judgment but a supplement to human wisdom.

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15. Figure 1. A conceptual frame work for the integration of AI and Data Science with Next Gen Libraries was created in Google Geminai by prompting for the required output, browsed on 13.08.2024,12.16pm.