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The Rise of AI Powered Libraries: A Review of Emerging Research Themes and Future Directions

Mr. Sandeep Sen

(Librarian)

Govt College Jaisinagar Sagar

Email id- sandeepsen5555@gmail.com

ABSTRACT :

Artificial Intelligence (AI) is rapidly transforming libraries from conventional information-access institutions into intelligent, personalized, and user-centred knowledge environments. This review examines the emerging role of AI in libraries by synthesizing literature on AI applications, service transformation, professional competencies, ethical concerns, institutional readiness, and future research directions. Adopting a narrative and integrative review approach, the study thematically analyses developments in artificial intelligence, machine learning, natural language processing, generative AI, and large language models within library and information services. The review highlights major applications including automated cataloguing and metadata generation, intelligent information retrieval, AI-based reference services, personalized recommendations, research support, digital preservation, and accessibility enhancement. Findings indicate that AI can improve operational efficiency, information discovery, personalization, continuous user assistance, and research support. However, significant challenges remain concerning user privacy, algorithmic bias, misinformation and AI hallucinations, copyright, infrastructure, professional competency, and unequal access. The study argues that AI should complement rather than replace librarians, fostering a human-AI collaborative model based on professional judgement, ethical governance, and AI literacy. The review further identifies research gaps related to empirical implementation, developing-country contexts, professional competency frameworks, responsible AI governance, and inclusive adoption. Overall, the future of AI-powered libraries depends on balancing technological innovation with trust, equity, professional ethics, and human-centred services.

Keywords: Artificial Intelligence; AI-Powered Libraries; Generative AI; Library Services; Librarian Competencies; AI Governance

1. Introduction

Libraries have historically served as essential institutions for collecting, organizing, preserving, and providing access to knowledge and information. However, rapid developments in digital technologies have substantially transformed the nature of library services, professional practices, and user expectations. The emergence of artificial intelligence (AI) represents a further and potentially more fundamental stage in this transformation. Unlike earlier technologies that primarily digitized or automated existing library processes, contemporary AI systems can analyse large volumes of data, recognize patterns, generate content, interpret natural language, personalize information services, and support complex decision-making. Consequently, AI is increasingly being viewed not merely as a technological tool but as an important component of the evolving information ecosystem. The integration of AI into libraries is not entirely new. Libraries have progressively experimented with machine learning, natural language processing, expert systems, automated classification, recommendation systems, intelligent search, and other forms of computational intelligence.

The development of these technologies has enabled libraries to improve information discovery, metadata creation, reference services, collection management, and user engagement (Cox, 2023). The emergence of generative artificial intelligence (GenAI), particularly large language model (LLM)-based applications, has accelerated this transformation by introducing new possibilities for conversational information retrieval, summarization, research assistance, content generation, translation, and personalized learning. Recent discussions within the international library community indicate that AI is increasingly influencing not only library operations but also the wider research and information landscape (IFLA, 2026).

AI therefore has the potential to transform libraries from predominantly information-access institutions into more intelligent, adaptive, personalized, and data-driven knowledge environments. Its applications may extend across several core library functions, including cataloguing and metadata generation, information retrieval, reference and advisory services, collection development, research support, user education, digital preservation, accessibility, and administrative decision-making. IFLA has identified areas such as content creation, classification, search and discovery, decision-support analytics, personalized learning, automated translation, and robotic applications as important areas in which AI may contribute to library development (IFLA, 2025). Similarly, recent research on academic libraries indicates that AI applications are particularly prominent in reference and information services, while institutions continue to face challenges related to funding, infrastructure, staff training, and organizational readiness (Boateng, 2024; [recent

systematic review source]]).

The growing presence of generative AI has also changed the nature of the relationship between libraries, information professionals, and users. Traditionally, librarians have acted as intermediaries between users and information resources by helping individuals identify, evaluate, retrieve, and use credible information. With conversational AI systems capable of producing immediate answers and summaries, this intermediary role is being reconsidered. Rather than making librarians less relevant, AI may shift professional responsibilities toward information verification, AI literacy, research consultation, data stewardship, ethical technology assessment, and the critical evaluation of machine-generated information. The Association of College and Research Libraries (ACRL, 2025) has consequently emphasized AI competencies for academic library workers, including ethical considerations, knowledge and understanding of AI technologies, analysis and evaluation, and appropriate use and application. This suggests that the future relevance of librarianship may increasingly depend on the ability of professionals to work collaboratively with AI while retaining human judgment and professional accountability.

At the same time, the adoption of AI introduces substantial ethical, professional, legal, and social challenges. AI systems depend heavily on data, algorithms, and computational infrastructures that may contain biases or reproduce existing inequalities. In the library context, these concerns are particularly significant because libraries are traditionally grounded in values such as intellectual freedom, privacy, equitable access, openness, diversity, and public trust. The use of AI can create concerns regarding the privacy of user data, algorithmic bias, misinformation, copyright and intellectual property, transparency, accountability, accessibility, and the potential displacement or restructuring of professional work. IFLA (2025) emphasizes that while AI offers considerable opportunities for libraries, it also raises important ethical and societal concerns, requiring library professionals to assess AI through the values of responsible, inclusive, and sustainable information provision.

Copyright represents another increasingly important issue. AI systems may be trained on large quantities of copyrighted and publicly available information, while libraries simultaneously seek to preserve and provide lawful access to knowledge resources. The intersection of AI development, copyright law, licensing, and library missions therefore presents complex questions regarding access, preservation, knowledge creation, and intellectual property. IFLA (2025) has highlighted the need to consider the implications of copyright law for both the development and use of AI while ensuring that the interests of libraries, researchers, educators, and information users are not overlooked. These concerns demonstrate that technological adoption alone cannot determine the future of AI-enabled libraries; rather, implementation must be accompanied by appropriate ethical, legal, institutional, and professional frameworks.

Despite the growing body of literature on AI and libraries, the existing discussion remains fragmented across technological applications, professional competencies, ethical concerns, user behaviour, and institutional adoption. Much of the literature focuses on individual applications or specific types of libraries, particularly academic libraries, while comparatively less attention has been given to understanding the broader transformation of libraries as socio-technical institutions. Furthermore, the rapid emergence of generative AI has created a continuously changing research environment in which earlier assumptions about automation, information retrieval, and professional roles require reconsideration. There is therefore a need for a comprehensive review that brings together technological, organizational, professional, ethical, and user-centred perspectives on AI adoption in libraries.

Against this background, the present review examines the transformation of libraries in the era of artificial intelligence by synthesizing existing literature on major AI applications, changing library services, evolving professional roles, institutional opportunities, and associated ethical and operational challenges. The review also considers the emergence of generative AI and identifies important gaps in existing scholarship. By bringing these dimensions together, the paper seeks to develop a holistic understanding of how AI is reshaping contemporary librarianship and to identify directions for future research and practice. The central argument of this review is that the future of AI-powered libraries should not be understood simply as a transition toward greater automation; rather, it should be conceptualized as a movement toward human-centred, intelligent, inclusive, ethical, and professionally governed information environments.

2. Review Methodology

This study adopts a narrative and integrative review approach to examine the emerging role of artificial intelligence (AI) in libraries and its implications for library services, professional roles, institutional practices, ethics, and future research. The review synthesizes relevant scholarly literature and professional perspectives concerning artificial intelligence, generative artificial intelligence, large language models, AI-enabled library services, librarian competencies, responsible AI governance, and inclusive adoption.

The literature was examined thematically rather than through a quantitative bibliometric or scientometric analysis. Particular attention was given to studies addressing AI applications in information retrieval, cataloguing and metadata generation, reference services, recommendation systems, research support, digital preservation, accessibility, AI literacy, professional transformation, privacy, algorithmic bias, copyright, and responsible AI governance.

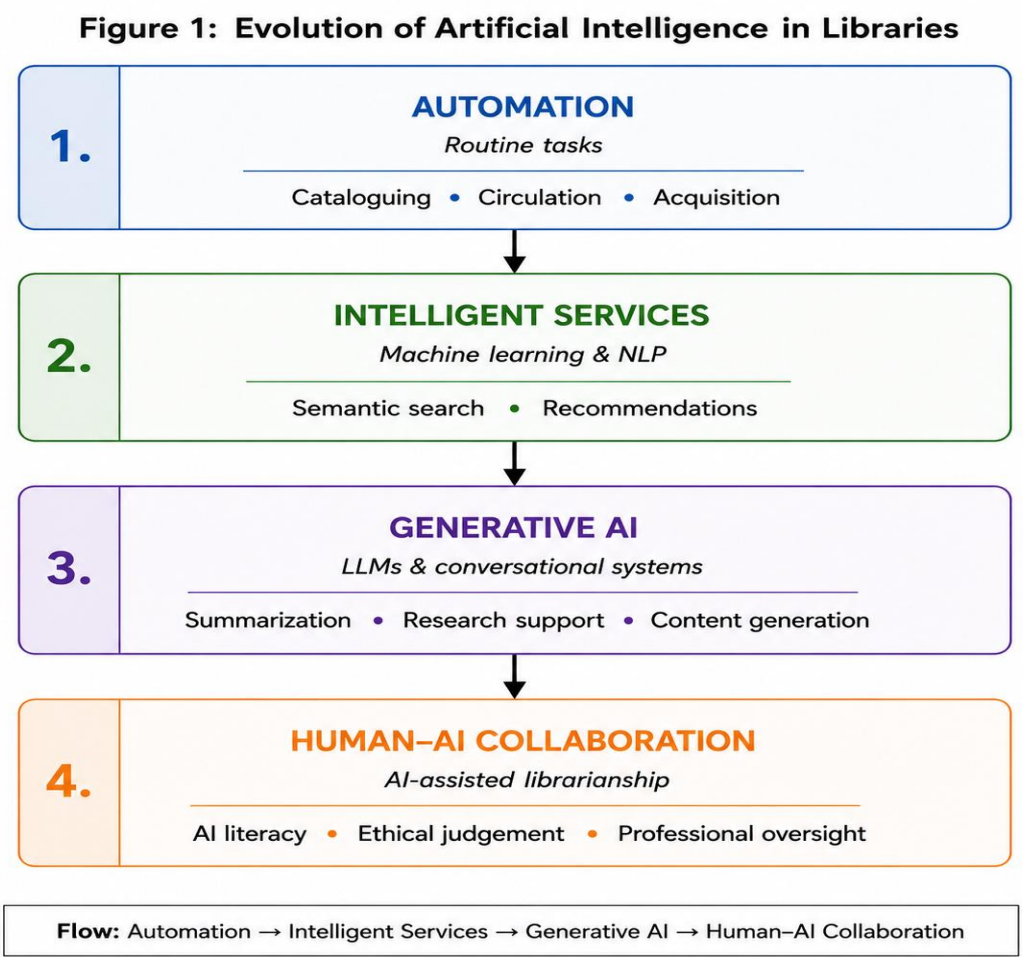
The reviewed literature was organized into major thematic dimensions: (i) the evolution of AI in libraries, (ii) major applications of AI, (iii) transformation of library services, (iv) changing roles and competencies of librarians, (v) benefits and opportunities, (vi) ethical and operational challenges, (vii) future directions, and (viii) research gaps and implications for library practice and policy. This thematic organization enables the study to synthesize

technological, professional, institutional, ethical, and user-centred dimensions of AI adoption. The review also considers the growing significance of generative AI and large language models in contemporary library environments. In addition, attention is given to differences in institutional capacity, infrastructure, professional competencies, and resource availability, particularly in relation to developing and resource-constrained library contexts. The review therefore seeks to provide a broad conceptual understanding of the transition toward AI-powered, human-centred, inclusive, and ethically governed library environments.

2. Evolution of Artificial Intelligence in Libraries

The integration of Artificial Intelligence (AI) into libraries has evolved from basic automation to intelligent and generative-AI-supported services. Initially, technology was primarily used to automate routine activities such as cataloguing, circulation, acquisition, and information retrieval. With advances in machine learning, natural language processing (NLP), and neural networks, AI applications gradually expanded toward classification, recommendation, semantic searching, and knowledge discovery (Cox, 2023; Wang et al., 2026). The development of intelligent library systems further enhanced user-oriented services. AI-based tools can support reference services, information retrieval, personalized recommendations, and automated responses to users' queries. A systematic review by Tella (2023) identified NLP and AI-based technologies as important emerging approaches in academic library reference services, while also highlighting concerns related to privacy, bias, information quality, infrastructure, and professional competencies.

Figure 1: AI Evolution Timeline

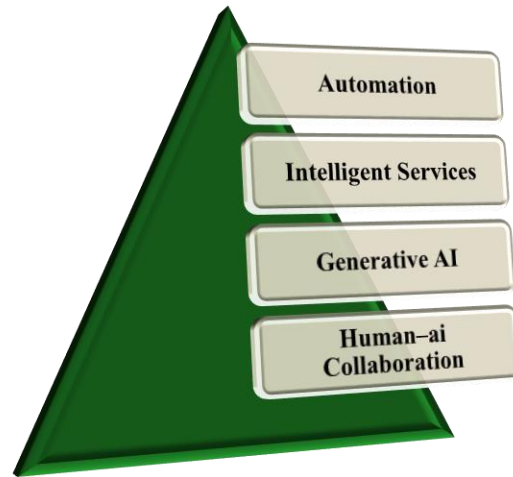


Note. Author's own conceptual synthesis based on the literature reviewed in the present study.

The emergence of generative AI and large language models (LLMs) has introduced a new phase in this transformation. Tools such as ChatGPT can assist with information searching, summarization, research support, translation, content generation, and user education. Consequently, libraries are increasingly exploring AI literacy and responsible use of generative AI rather than focusing solely on technological automation (Ko & Chiu, 2024; Guo et al., 2024). AI is also changing the role of librarians. Routine and repetitive activities may increasingly be automated, allowing librarians to focus on research support, information evaluation, AI literacy, ethical guidance, and personalized user services. Cox (2023) argues that AI may contribute to a more hybrid

professional environment in which librarians collaborate with intelligent technologies rather than simply compete with them.

However, the evolution of AI in libraries also raises concerns regarding **privacy, algorithmic bias, copyright, misinformation, transparency, and equitable access**. Therefore, contemporary AI adoption requires a human-centred and ethically responsible approach. Overall, the development of AI in libraries can be viewed as a transition from;



Automation, intelligent services, generative AI, human-AI collaboration, fundamentally reshaping the future role of libraries and information professionals (Cox, 2023; Wang et al., 2026).

3. Major Applications of Artificial Intelligence in Libraries

Artificial Intelligence is increasingly being applied across different areas of library operations and services. Its applications range from routine administrative functions to advanced information discovery and personalized user support. The major applications are discussed below.

3.1 AI in Cataloguing and Metadata

AI can automate and enhance cataloguing, classification, indexing, and metadata generation by identifying bibliographic information and assigning relevant descriptors. Machine learning and natural language processing can reduce repetitive work and improve the consistency of metadata, particularly for large digital collections (Cox, 2023; Wang et al., 2026).

3.2 Intelligent Information Retrieval

AI has significantly enhanced information retrieval by enabling systems to understand natural-language queries, identify semantic relationships, and provide more relevant search results. AI-supported discovery systems can therefore move beyond traditional keyword-based searching toward more contextual and personalized information retrieval (Tella, 2023; Wang et al., 2026).

3.3 AI-Based Reference Services

Chatbots and conversational AI can provide immediate responses to frequently asked questions and assist users in navigating library resources. Such systems can extend reference support beyond conventional service hours. However, librarians remain important for complex research queries and the verification of information provided by AI systems (Tella, 2023).

3.4 Personalized Recommendation Services

AI can analyse users' search behaviour, interests, and previous interactions to recommend books, articles, databases, and other relevant resources. Such recommendation systems can improve information discovery and create more personalized library experiences (Cox, 2023).

3.5 Generative AI and Research Support

Generative AI has introduced new possibilities for literature searching, summarization, translation, brainstorming, research assistance, and information-

literacy education. Academic libraries are increasingly developing guidance to help users understand the capabilities and limitations of generative AI and to use such technologies critically and ethically (Ko & Chiu, 2024; Guo et al., 2024).

3.6 Collection Development and Decision-Making

AI-based analytics can assist libraries in analysing usage patterns and identifying trends in resource demand. Such information can support collection development, resource allocation, and service planning. However, AI-generated recommendations should complement rather than replace professional judgement (Cox, 2023).

3.7 Digital Preservation and Accessibility

AI can contribute to digital preservation through automated classification, image and text recognition, metadata creation, and identification of digital content. AI-based tools can also improve accessibility through automated transcription, translation, text-to-speech, and other assistive technologies. Overall, AI applications are expanding libraries from **automated information centres toward intelligent, personalized, and user-centred knowledge environments**. Nevertheless, successful adoption depends on technological infrastructure, staff competencies, ethical governance, data quality, and continuous professional development (Cox, 2023; Tella, 2023).

4. Transformation of Library Services Through Artificial Intelligence

The integration of Artificial Intelligence is transforming library services from conventional, largely reactive models toward more personalized, automated, and proactive approaches. AI enables libraries to analyse large volumes of information and user interactions, thereby improving the efficiency, accessibility, and responsiveness of services (Cox, 2023).

Table 1; Transformation from Traditional to AI-Powered Library Services

Dimension	Traditional Library	AI-Powered Library
Service model	Primarily reactive	Increasingly proactive
Information retrieval	Keyword and metadata-based	Semantic and conversational
Reference services	Human-led	AI-assisted and human-supervised
Recommendations	General or librarian-mediated	Personalized and data-informed
Routine processing	Primarily manual	Increasingly automated
Research support	Librarian-led	AI-assisted with professional verification
Accessibility	Conventional assistive services	AI-enhanced translation, transcription and text-to-speech
User support	Mainly within service hours	Potentially continuous/24/7 AI assistance
Professional role	Information intermediary	AI literacy educator, evaluator and knowledge mediator

4.1 Personalized User Services

AI can analyse users' information needs and interaction patterns to provide personalized recommendations and search results. Such systems can help users discover relevant books, articles, databases, and other resources more efficiently. Personalization can therefore improve user engagement and the overall library experience (Cox, 2023).

4.2 Automated Reference Services

AI-powered chatbots and virtual assistants can provide immediate responses to routine queries, guide users toward appropriate resources, and offer basic research assistance. This can extend reference support beyond traditional service hours while allowing librarians to concentrate on more complex information needs (Tella, 2023).

4.3 Intelligent Search and Discovery

Traditional library discovery systems largely depend on keywords and structured metadata. AI enables more natural-language and semantic searching, allowing systems to interpret user intent and identify relationships between information resources. This development can make information discovery faster and more intuitive (Wang et al., 2026).

4.4 Research and Academic Support

Generative AI is creating new opportunities for libraries to support researchers and students through summarization, translation, brainstorming, literature exploration, and research-skills development. At the same time, librarians increasingly need to teach users how to evaluate AI-generated information, recognize limitations, and use AI ethically (Ko & Chiu, 2024; Guo et al., 2024).

4.5 Improved Accessibility and Inclusion

AI-based speech recognition, translation, text-to-speech, optical character recognition, and other assistive technologies can make library resources more accessible to users with different linguistic and physical needs. Thus, AI has the potential to contribute to more inclusive library services when implemented with accessibility and equity in mind.

4.6 From Reactive to Proactive Libraries

Perhaps the most significant transformation is the shift from **reactive service delivery to proactive information support**. Instead of waiting for users to formulate queries, AI systems can potentially identify patterns, anticipate information needs, and recommend relevant resources. However, such personalization must be balanced with privacy, transparency, and user autonomy.

Overall, AI is reshaping library services by combining **automation, personalization, intelligent discovery, and research support**. The future effectiveness of these services will depend not simply on technological adoption but on the ability of libraries to integrate AI with professional expertise and core library values (Cox, 2023; Tella, 2023).

5. Changing Role and Competencies of Librarians in the AI Era

The increasing adoption of Artificial Intelligence is not only transforming library services but also redefining the professional role of librarians. As routine activities such as cataloguing, basic reference assistance, metadata generation, and information retrieval become increasingly automated, librarians are expected to focus more on analytical, educational, ethical, and user-centred responsibilities (Cox, 2023).

Librarians are increasingly becoming **AI literacy educators and information evaluators**. They need to help users understand how AI systems work, assess the credibility of AI-generated information, identify misinformation and bias, and use generative AI responsibly. Research on librarians in the generative-AI environment emphasizes the growing importance of critical thinking, information and data literacy, technological awareness, and collaborative skills (Guo et al., 2024).

AI adoption also requires librarians to develop competencies in areas such as **data management, prompt formulation, AI-tool evaluation, digital ethics, privacy, copyright, and algorithmic bias**. These competencies can enable professionals to work effectively with AI while maintaining human oversight and professional accountability (Cox, 2023).

Importantly, AI should not be viewed simply as a technology that replaces librarians. Rather, it can support a **human–AI collaborative model**, in which machines perform repetitive and data-intensive tasks while librarians provide contextual interpretation, critical judgement, ethical guidance, and personalized assistance. This shift may strengthen rather than diminish the professional value of librarianship.

However, differences in technological infrastructure, training opportunities, institutional support, and digital competencies may create unequal levels of AI readiness among library professionals. Continuous professional development and institutional training are therefore essential for effective AI adoption (Tella, 2023).

Thus, the future librarian is likely to be less focused on routine information processing and more focused on **AI-enabled knowledge mediation, research support, information literacy, ethical governance, and human-centred service delivery**. This transformation makes professional adaptability and lifelong learning increasingly important for the sustainability of librarianship in the AI era.

6. Benefits of Artificial Intelligence in Libraries

The adoption of Artificial Intelligence offers several opportunities for improving the efficiency, quality, and accessibility of library services. By automating repetitive activities and analysing large volumes of information, AI can enable libraries to use their resources more effectively and provide more responsive services to users (Cox, 2023).

6.1 Improved Operational Efficiency

AI can automate time-consuming activities such as metadata creation, classification, document processing, routine queries, and data analysis. This can

reduce repetitive workloads and allow librarians to devote greater attention to research support and user-oriented activities (Wang et al., 2026).

6.2 Faster Information Discovery

AI-supported search and recommendation systems can analyse user queries and information resources more intelligently than conventional keyword-based systems. This can help users identify relevant materials more quickly and improve the overall effectiveness of information retrieval (Tella, 2023).

6.3 Personalized Services

AI can support personalized recommendations based on users' interests, search behaviour, and information needs. Such personalization can improve user engagement and make library services more relevant to individual users (Cox, 2023).

6.4 24/7 User Assistance

AI chatbots and virtual assistants can provide basic information and answer routine questions at any time. This can extend the availability of library support beyond conventional operating hours and reduce pressure on frontline staff (Tella, 2023).

6.5 Enhanced Research Support

Generative AI can assist students and researchers with tasks such as summarization, translation, brainstorming, information exploration, and research communication. Libraries can also use these technologies to strengthen AI literacy and research-support services (Ko & Chiu, 2024).

6.6 Accessibility and Inclusion

AI-based speech recognition, translation, optical character recognition, and text-to-speech technologies can improve access to information for users with different linguistic and accessibility needs. Consequently, responsible AI adoption may contribute to more inclusive library environments.

Overall, the major benefits of AI can be summarized as **greater efficiency, improved information discovery, personalization, continuous service availability, enhanced research support, and improved accessibility**. However, these benefits can be realized effectively only when AI implementation is supported by appropriate infrastructure, trained professionals, reliable data, and ethical governance (Cox, 2023; Guo et al., 2024).

7. Challenges and Ethical Concerns of AI Adoption in Libraries

Despite its potential benefits, the adoption of Artificial Intelligence in libraries also creates significant technological, ethical, professional, and social challenges. Since libraries are institutions built around principles of privacy, intellectual freedom, equitable access, and public trust, AI implementation must be carefully aligned with these values (Cox, 2023).

Table 2; Opportunities and Challenges Associated with AI Adoption in Libraries

AI Opportunity	Potential Challenge
Automation of routine activities	Workforce restructuring and changing job responsibilities
Personalized information services	User privacy and data protection
Intelligent search and discovery	Algorithmic bias and unequal visibility
Generative AI research support	Hallucinations and misinformation
24/7 user assistance	Excessive dependence on AI
AI-assisted decision-making	Transparency and accountability
Accessibility enhancement	Unequal access to digital infrastructure
Data-driven collection development	Data quality and governance concerns
AI-enabled learning support	Need for AI literacy and professional training

7.1 Privacy and Data Protection

AI systems often require large amounts of data to provide personalized services. The collection and processing of users' search histories, borrowing patterns, and interaction data can therefore create privacy risks. Libraries need clear policies regarding data collection, storage, sharing, and algorithmic processing.

7.2 Algorithmic Bias

AI systems can reproduce or amplify biases present in their training data. Biased algorithms may influence search results, recommendations, classification, and access to information. This can negatively affect information diversity and equitable service delivery (Tella, 2023).

7.3 Misinformation and AI Hallucinations

Generative AI systems may produce inaccurate, incomplete, or fabricated information while presenting it in a convincing manner. This is particularly important in libraries because users often depend on library professionals for reliable information. Consequently, verification and critical evaluation of AI-generated content have become essential professional responsibilities (Ko & Chiu, 2024).

7.4 Copyright and Intellectual Property

The use of AI-generated and AI-assisted content raises complex questions concerning copyright, authorship, licensing, and intellectual property. Libraries must therefore consider both users' access to information and the rights of content creators when adopting AI technologies.

7.5 Professional Competency and Training

Successful AI adoption requires librarians to develop new technical and analytical competencies. However, differences in training, digital literacy, infrastructure, and institutional support may create significant gaps in AI readiness among professionals (Guo et al., 2024).

7.6 Cost and Infrastructure

Advanced AI systems may require substantial investments in computing infrastructure, software, data management, cybersecurity, and staff training. Smaller and resource-constrained libraries may therefore face greater difficulties in adopting sophisticated AI technologies.

7.7 Human-AI Dependence

Excessive dependence on AI may reduce human oversight and weaken critical evaluation. AI should therefore be regarded as a support mechanism rather than a complete replacement for professional judgement. Maintaining meaningful human involvement is particularly important when decisions affect information access, privacy, or user rights (Cox, 2023).

Overall, the challenges associated with AI demonstrate that **technological capability alone cannot determine successful AI adoption**. Libraries require ethical policies, staff training, data protection mechanisms, transparency, and human oversight to ensure that AI remains consistent with core library values. A responsible approach is therefore essential for developing trustworthy and sustainable AI-powered libraries.

Table 3; Critical Synthesis of Major Dimensions of AI Adoption in Libraries

Dimension	Potential Contribution	Major Concern	Future Research Need
Library service delivery	Greater efficiency and personalization	Dependence on automated systems	Empirical evaluation of service outcomes
Information retrieval	Faster and more contextual discovery	Bias and information quality	Accuracy and relevance assessment
Generative AI	Research assistance and information-literacy support	Hallucinations and fabricated information	Verification and reliability studies
Librarian roles	Shift toward higher-level knowledge work	Skills and training gaps	AI competency frameworks
Data-driven decision-making	Improved planning and resource allocation	Privacy and transparency	Responsible data-governance models
AI governance	More structured and accountable adoption	Ethical and legal uncertainty	Evidence-based governance frameworks
Global adoption	Opportunities for inclusive innovation	Digital and infrastructure divide	Comparative international research

8. AI and the Future of Libraries

The future of libraries is likely to be shaped by the continued development of Artificial Intelligence, particularly generative AI, large language models, machine learning, and intelligent information systems. Rather than replacing traditional library functions, these technologies are expected to create new forms of service delivery and strengthen the library's role as a trusted knowledge institution.

One important direction is the development of **intelligent and personalized libraries**. AI can enable systems to understand user needs, recommend relevant resources, and provide context-sensitive assistance. This may gradually shift libraries from conventional service models toward more proactive and personalized information environments (Cox, 2023).

Generative AI is likely to have an especially significant influence. Libraries can use LLM-based tools for research assistance, information-literacy education, summarization, translation, and conversational discovery. At the same time, librarians will need to help users distinguish reliable information from AI-generated misinformation and understand the limitations of these systems (Ko & Chiu, 2024).

Another important future direction is **human–AI collaboration**. AI may increasingly perform repetitive and data-intensive tasks, while librarians focus on critical evaluation, research consultation, ethical decision-making, and user education. This suggests that the future librarian will require a combination of traditional LIS knowledge and AI-related competencies (Guo et al., 2024).

The future development of AI-powered libraries will also depend on **responsible AI governance**. Issues related to privacy, copyright, algorithmic transparency, bias, accessibility, and equitable access will need to be incorporated into institutional policies. Libraries, therefore, should not adopt AI simply because it is technologically advanced; its implementation should be consistent with professional values and community needs.

Finally, AI may contribute to reducing information-access inequalities if implemented inclusively. However, differences in digital infrastructure, funding, technical expertise, and AI literacy may create new forms of inequality between well-resourced and resource-constrained libraries. Future research should therefore examine AI adoption across different geographical, institutional, and socioeconomic contexts.

Overall, the future library can be conceptualized as a **human-centred intelligent knowledge environment**, where AI enhances discovery, personalization, accessibility, and efficiency while librarians remain responsible for critical judgement, ethical guidance, and trusted human interaction.

. Global Perspectives on AI Adoption in Libraries

The development of AI-powered libraries is occurring within diverse technological, institutional, economic, and social contexts. Although AI applications are increasingly being explored in technologically advanced library environments, the capacity to adopt and implement these technologies varies considerably across countries, institutions, and types of libraries. Differences in digital infrastructure, funding, technical expertise, data availability, institutional readiness, and professional training can substantially influence the extent and effectiveness of AI adoption.

In technologically advanced environments, libraries may have greater access to sophisticated AI infrastructure, digital collections, intelligent discovery systems, generative AI tools, and specialized professional training. These environments provide opportunities for experimentation with personalized services, conversational information retrieval, automated metadata generation, research support, and AI-assisted decision-making. However, even well-resourced institutions must address concerns related to privacy, algorithmic bias, copyright, transparency, information accuracy, and professional accountability.

In developing and resource-constrained contexts, the adoption of AI may be influenced more strongly by limitations in infrastructure, funding, connectivity, technical expertise, and access to appropriate training. Such differences may create an AI adoption divide between well-resourced and resource-constrained libraries. Consequently, the global development of AI-powered libraries should not be evaluated solely in terms of technological capability but also in relation to affordability, accessibility, institutional capacity, and professional readiness.

A globally inclusive approach therefore requires attention to different types of libraries and diverse socioeconomic contexts. Academic, public, special, and research libraries may have different priorities and levels of technological preparedness. Comparative research across countries and regions can provide valuable insights into how AI adoption is shaped by institutional environments, professional cultures, policy frameworks, and resource availability.

The global development of AI-powered libraries should ultimately be guided by the principle that technological innovation must remain compatible with equitable access, professional ethics, user privacy, cultural and linguistic diversity, and community needs. A globally representative research agenda can therefore contribute to the development of AI-enabled library services that are not only technologically advanced but also inclusive, sustainable, and responsive to different information environments.

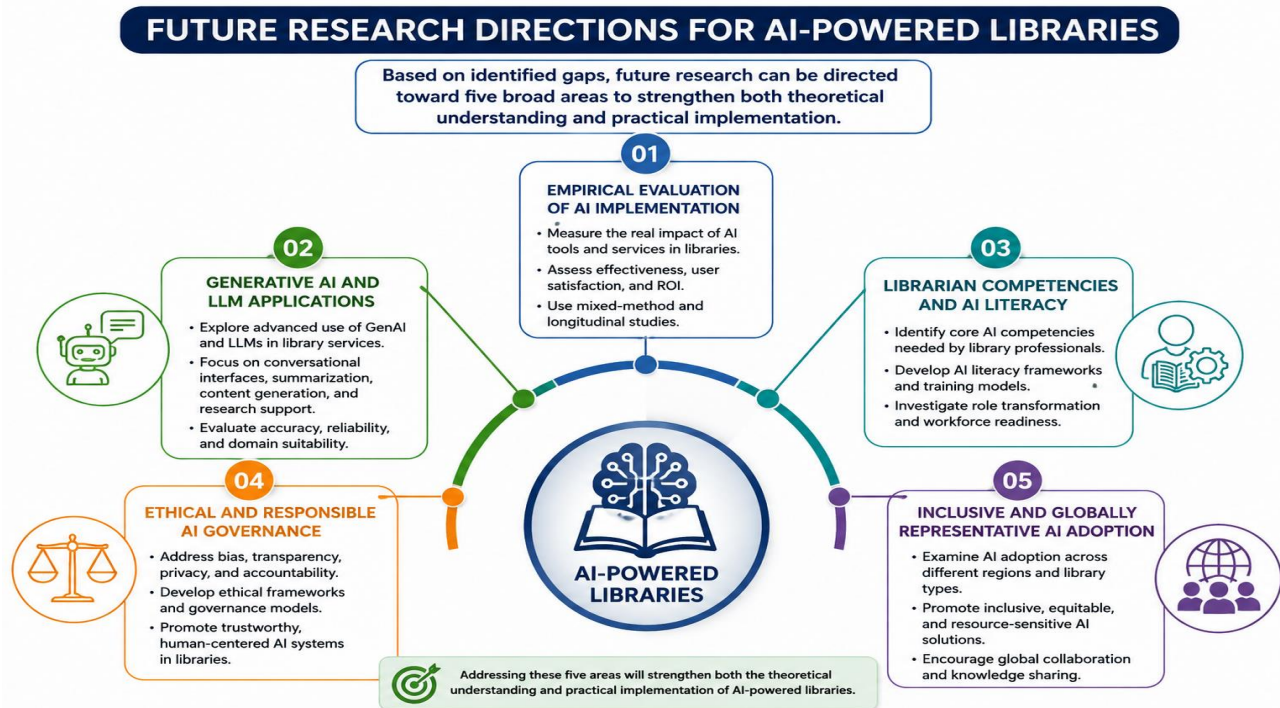
9. Research Gaps and Future Directions

Although research on Artificial Intelligence in libraries is expanding rapidly, several important gaps remain. Existing studies have largely focused on individual AI applications, academic libraries, reference services, and the potential of generative AI, while comparatively less attention has been given to the long-term institutional, social, and professional consequences of AI adoption (Cox, 2023; Wang et al., 2026).

First, there is a need for more **empirical research on actual AI implementation**. Much of the existing literature discusses potential applications rather than evaluating the outcomes of AI-based systems in real library environments. Future studies should examine user satisfaction, service quality, efficiency, cost-effectiveness, and organizational performance following AI adoption. Second, greater attention should be given to **developing countries and resource-constrained libraries**. Existing research is disproportionately concentrated in technologically advanced academic environments. Comparative studies involving libraries in Asia, Africa, and other emerging economies could provide a more balanced understanding of global AI adoption.

Third, the rapid development of **generative AI and large language models** requires continuous research. Future studies should examine their accuracy, hallucination risks, research applications, information-literacy implications, and impact on academic libraries and scholarly communication. Fourth, **AI literacy and professional competencies** require greater attention. Research should identify the specific technical, analytical, ethical, and pedagogical skills librarians need and develop competency frameworks and effective professional-development models (Guo et al., 2024).

Fifth, further research is required on **ethical and governance issues**, particularly privacy, algorithmic bias, copyright, transparency, accountability, and intellectual freedom. Libraries need evidence-based frameworks that can guide responsible AI procurement, implementation, evaluation, and monitoring. Finally, future research should increasingly examine **human–AI collaboration rather than AI replacement**. Understanding how librarians and intelligent systems can complement each other may provide a more realistic and sustainable model for the future of librarianship.



(Source: Author's compilation based on the research gaps identified in the present study.)

10. Implications for Library Practice and Policy

The growing integration of Artificial Intelligence has important implications for library management, professional practice, and institutional policy. AI adoption should be approached as an organizational transformation rather than merely as the introduction of new software or technological tools.

10.1 Implications for Library Management

Library administrators need to develop clear AI adoption strategies that identify appropriate applications, expected outcomes, resource requirements, and potential risks. AI implementation should be aligned with institutional objectives and user needs rather than driven solely by technological trends (Cox, 2023).

10.2 Implications for Librarians

Librarians require continuous professional development in AI literacy, data management, prompt development, information evaluation, privacy, copyright, and ethical technology use. Professional training should combine technical knowledge with traditional LIS competencies so that librarians can effectively collaborate with AI systems (Guo et al., 2024).

10.3 Implications for Users

Libraries have an important role in developing **AI literacy among users**. Users should be equipped to understand the strengths and limitations of AI tools, verify AI-generated information, recognize bias and misinformation, and use generative AI responsibly. This expands the traditional role of libraries in information literacy toward broader AI and digital literacy (Ko & Chiu, 2024).

10.4 Implications for Policy and Governance

Libraries should establish policies addressing privacy, data protection, copyright, algorithmic transparency, accessibility, and responsible AI use. Human oversight should remain central when AI systems influence information access or user-related decisions.

10.5 Implications for Equity and Inclusion

AI strategies should also consider the digital divide. Libraries with limited financial and technological resources may face greater barriers to AI adoption. Policymakers and library networks should therefore promote affordable infrastructure, shared resources, training opportunities, and inclusive AI initiatives.

Overall, effective AI adoption requires a **balanced approach combining technological innovation with professional judgement, ethical governance, user needs, and institutional responsibility**. Such an approach can enable libraries to benefit from AI while preserving their fundamental values as trusted and inclusive knowledge institutions.

11. Conclusion

Artificial Intelligence is emerging as an important force in the transformation of contemporary libraries. Its applications in cataloguing, information retrieval, reference services, recommendation systems, research support, accessibility, and generative AI are creating opportunities to make library services more efficient, personalized, responsive, and accessible (Cox, 2023; Tella, 2023).

However, the transformation is not solely technological. AI is also changing the professional responsibilities of librarians, requiring greater competencies in AI literacy, information evaluation, data management, ethics, and research support (Guo et al., 2024). At the same time, concerns regarding privacy, algorithmic bias, misinformation, copyright, infrastructure, and unequal access demonstrate that AI adoption must be carefully governed.

The future of libraries should therefore not be understood as a movement toward complete automation or the replacement of librarians. Instead, it is more appropriately viewed as a transition toward **human-AI collaboration**, in which AI performs computational and repetitive tasks while librarians provide professional judgement, contextual understanding, ethical guidance, and human-centred services. Generative AI further strengthens the need for libraries to become centres of AI literacy and critical information evaluation (Ko & Chiu, 2024).

Ultimately, the success of AI-powered libraries will depend on their ability to balance **innovation with trust, efficiency with human judgement, and technological advancement with equity and professional ethics**. Future research should therefore move beyond discussing the potential of AI and increasingly examine its real-world implementation, measurable outcomes, professional implications, and long-term societal effects. Such an approach can help libraries develop intelligent yet responsible knowledge environments that remain relevant to the changing needs of users in the digital age.

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