



The Role of Artificial Intelligence in Enhancing Library Services: A Systematic Review

Chisom Obi

Abstract:

Artificial Intelligence (AI) is rising fast. In its application in library and information science, it has greatly transformed how information is managed, accessed, and disseminated. This systematic review examines the role of AI in enhancing library services across various domains, including cataloging, recommendation systems, Chatbots/virtual assistance, digital preservation and archiving, and predictive analytics. Drawing on peer-reviewed literature, institutional reports, and gray literature published between 2015 and 2024, the study focuses on synthesizing key thematic findings to identify technological trends, practical applications, and strategies employed by libraries worldwide. This study employed and strictly adhered to PRISMA 2020 guidelines, and 50 relevant studies were studied in the final review from an initial 500 studies retrieved. The findings identified the obvious shift of libraries towards automation, intelligent systems, and predictive analytics that support services that are user-oriented and enhance operations. Even though AI has promising benefits, this study identifies key challenges faced during AI adoption, particularly concerning data privacy, transparency, algorithm bias, infrastructural gaps, funding, and workplace displacement. The study concludes by providing strategic recommendations for librarians, policymakers, and technology experts, as well as suggestions for further studies for LIS professionals seeking to fully integrate AI into the library system. The study comprehensively synthesizes existing literature and contributes to informed decision-making, critical reflection, and scholarly discussions on the future of AI-powered libraries.

To cite this article:

Obi, C. (2026). The Role of Artificial Intelligence in Enhancing Library Services: A Systematic Review. *International Journal of Librarianship*, 11(1), 33-46.
<https://doi.org/10.23974/ijol.2026.vol11.1.521>

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The Role of Artificial Intelligence in Enhancing Library Services: A Systematic Review

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ABSTRACT

Artificial Intelligence (AI) is rising fast. In its application in library and information science, it has greatly transformed how information is managed, accessed, and disseminated. This systematic review examines the role of AI in enhancing library services across various domains, including cataloging, recommendation systems, Chatbots/virtual assistance, digital preservation and archiving, and predictive analytics. Drawing on peer-reviewed literature, institutional reports, and gray literature published between 2015 and 2024, the study focuses on synthesizing key thematic findings to identify technological trends, practical applications, and strategies employed by libraries worldwide. This study employed and strictly adhered to PRISMA 2020 guidelines, and 50 relevant studies were studied in the final review from an initial 500 studies retrieved. The findings identified the obvious shift of libraries towards automation, intelligent systems, and predictive analytics that support services that are user-oriented and enhance operations. Even though AI has promising benefits, this study identifies key challenges faced during AI adoption, particularly concerning data privacy, transparency, algorithm bias, infrastructural gaps, funding, and workplace displacement. The study concludes by providing strategic recommendations for librarians, policymakers, and technology experts, as well as suggestions for further studies for LIS professionals seeking to fully integrate AI into the library system. The study comprehensively synthesizes existing literature and contributes to informed decision-making, critical reflection, and scholarly discussions on the future of AI-powered libraries.

Keywords: Artificial Intelligence, Recommendation Systems, Chatbots, Machine Learning, Systematic Review, Digital Libraries, Cataloging, Predictive Analytics, User Engagement

INTRODUCTION

For a long time, libraries have been a Centre for knowledge processing, access, and retrieval. These library functions have always been performed using traditional/manual methods. However, in the digital age, there has been a shift as library processes have been greatly influenced by technology, particularly artificial intelligence (AI). AI refers to the ability of computers to perform tasks such as learning, problem-solving, and decision-making that would typically require human intelligence. Russell & Norvig (2021) confirm that AI encompasses computational systems

capable of performing tasks that typically require human intelligence, including learning, problem-solving, natural language processing, pattern recognition, and generating actionable insights. In libraries, AI has transformed the way core functions, such as information retrieval, acquisition, and cataloging, as well as user support, are performed.

Adoption of AI in library services stems from the need to personalize services, rapid data processing, and enhanced user experience. Every other sector that embraced AI improved its services, so it is not surprising that the library is not left out. Libraries are now leveraging machine learning, automated metadata generation to inform decision-making and improve user experience. Reinsel, Gantz, & Rydning (2017) projected that global information production will exceed 180 zettabytes in 2025.

AI adoption in library services has since evolved from an experimental level to actual operation since 2015. Early AI adopters reported efficiency gains in cataloging and reference services (Adams & Van Manen, 2020), yet there are still so many gaps.

This paper aims to critically examine literature from 2015 to 2025 to provide a systematic review of the role of AI in enhancing library services, identify key themes, analyze emerging applications, point out benefits and limitations, as well as provide actionable insights on the way forward. By consolidating current knowledge, the study contributes to both theoretical and practical understanding of AI's transformative potential in libraries.

OBJECTIVES

1. Identify AI applications across library service domains.
2. Evaluate benefits, limitations, and ethical implications.
3. Provide actionable recommendations for future adoption.

RESEARCH METHODOLOGY

This review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (Page et al., 2021), and it involved a comprehensive literature search among various academic and gray literature sources.

Inclusion criteria:

- Articles published between January 2015 to December 2024
- Publication type includes peer-reviewed articles, conference proceedings, government/organizational reports, and gray literature.
- Publications focused on the application of AI in academic, public, or special libraries.
- Papers written in English

Exclusion Criteria:

- Studies published before 2015, and studies that are focused on the theoretical aspects of AI
- Opinion pieces, editorials, or abstracts without full texts.
- Studies that are not written in English.
- Studies that focused on non-library contexts.

Database searched

The following databases were searched and queried in 2024

1. Scopus,
2. Web of Science
3. IEEE Xplore
4. Library and Information Science Source (LISS)
5. ACM Digital Library
6. PubMed
7. Google Scholar (first 200 relevance-ranked results of gray literature)

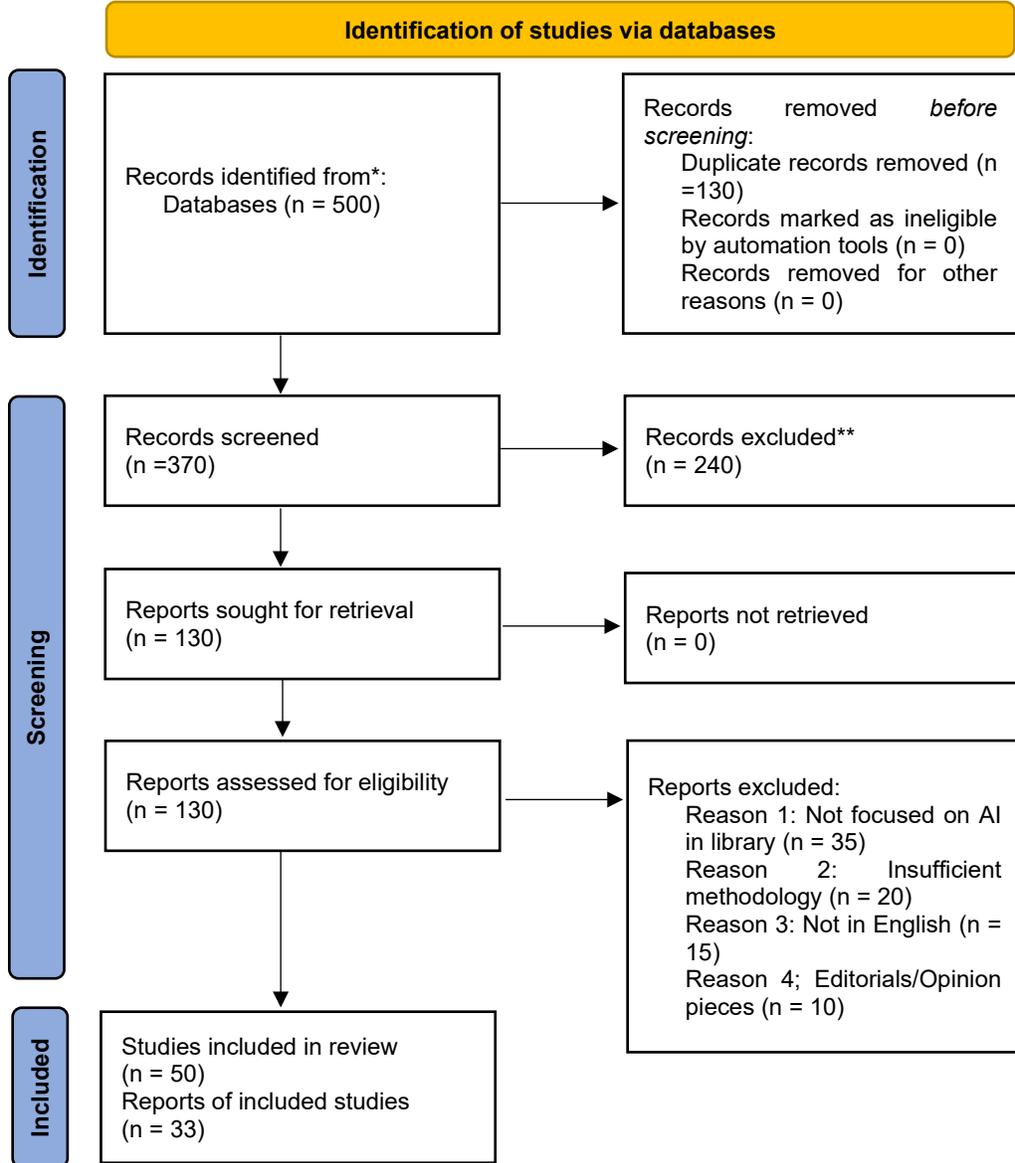
Search Strategy

The search terms included combinations of the following: "artificial intelligence", "machine learning", "library services", "digital libraries", "AI in libraries", "cataloging automation", "AI Chatbots", and "predictive analytics in libraries". Boolean operators (AND, OR) were used to refine results.

Review Protocol and Selection

A total of 500 records were initially retrieved from the selected databases. After removing 130 duplicates, 370 titles and abstracts were screened. Following the screening process, 240 records were excluded. The remaining 130 full-text articles were assessed for eligibility, with 80 articles excluded based on predefined criteria. Ultimately, 50 studies were included in this systematic review. Figure 1 presents the PRISMA 2020 flow diagram summarizing the study selection process.

Figure 1. PRISMA 2020 flow diagram illustrating the study selection process for the systematic review.



LITERATURE REVIEW

Thematic Findings

AI in Cataloguing and Metadata Generation

Cataloguing is the process of creating detailed records of library materials, making them easy to identify and retrieve. This involves creating metadata such as the author's name, publication details, title of the book, classification number, etc.

Joudrey, Taylor, and Miller 2015 define cataloguing as the process of creating metadata for resources by describing a resource, choosing name, and title access points, conducting subject analysis, assigning subject headings, and classification numbers, and maintaining the system through which the cataloging data is made available. This task was traditionally done manually before the advent of automation and takes a lot of time.

However, with artificial intelligence, it gets even better. AI, when incorporated into cataloguing, helps to automate its processes, thereby reducing human errors and improving metadata accuracy. It reduces task burden, saves time, and enables library staff to focus on more productive activities. According to Zhang et al. (2023), AI automates resource classification and metadata tagging, reducing processing time by 30 – 70%. Suryawanshi (2024) goes on to assert that AI has revolutionized cataloguing by automating metadata extraction and classification, significantly reducing errors and manual labor

Additionally, Natural Language Processing (NLP) models, such as BERT, help extract keywords and generate summaries for digital collections. NLP algorithms also analyze content to assign accurate subject headings, improving resource discoverability (Harisanty et al., 2023). Also, tools like OCLC's SmartCAT and AI-driven subject indexing systems have become widespread (Hider & Tan, 2022).

IFLA Report 2024 also talks about an emerging trend, Large Language Models (LLMs) like GPT-4 that can create rich metadata for non-textual objects like audio and video, even though there is an issue of accuracy, especially for low-resource languages.

However, it's still important that a Librarian vet and review records to ensure the library policy is strictly adhered to.

Recommendation Systems

Recommendation systems are AI-powered tools that provide users with personalized suggestions for items, content, or information they might find relevant. According to Ekstrand (2018), recommender tools have become an essential tool in many domains, including e-commerce, online media, and libraries, helping users find relevant materials in a vast collection. In the library, Barsha & Munshi (2023) and Kaushal & Yadav (2022) affirms that recommender systems analyze user borrowing history, search patterns, and preferences to tailor resource suggestions. This means that

with the help of AI, the borrowing history, search queries, and ratings are used to suggest personalized library resources to users. The library collects user data and feeds the algorithm for selection. It then analyzes this data and provides recommendations based on the insights. Ali (2024) retorts that AI recommendation systems enhance user engagement by providing personalized experiences that encourage exploration of library resources.

AI-powered recommendation systems have been implemented in so many libraries, providing personalized book recommendations and enhancing user engagement. It has revolutionized the way library patrons interact with library collections. A study by Liao (2019) found that personalized recommendation systems can increase user satisfaction and loyalty, and can also help users discover new resources that they may not have found otherwise. Furthermore, a paper by Tsai (2017) noted that the use of recommendation systems in libraries can lead to increased circulation of materials, improved user satisfaction, and enhanced user experience.

Moreover, AI-powered recommendation systems can confidently assist libraries in catering to different user needs. For example, Xiao (2020) discovered that recommendation systems can be designed to take into account user preferences, reading habits, and learning styles, providing personalized recommendations that meet individual needs. By harnessing these systems, libraries can provide more tailored and inclusive services to their patrons. AI-driven recommender systems have proved to be a very beneficial asset to the library. It provides improved discovery for users to discover new books they might not have discovered, enhancing user experience by providing personalized services, which makes library usage more fun. It saves time by enabling users to find materials quickly without browsing through the entire collection. Recommendations are tailored to each user's preferences and interests.

For the library and librarians, AI-powered recommendation systems increase resource utilization, improve efficiency, enhance user engagement, and provide data-driven insights. The benefits can never be overemphasized; they are multifaceted as they not only enhance user engagement but also help libraries maximize their services and collections by providing data-driven insights. As Won (2019) noted, recommender systems can help libraries identify gaps in their collections and make informed decisions about future acquisitions.

Another amazing part is that these systems continue to improve on their own as long as the required data is provided. Barsha & Munshi (2023) and Cox & Mazumdar (2022) in their respective studies assert that machine learning models continually refine recommendation systems based on user feedback and behavior. However, concerns have been raised about the privacy and security of user data. Kaushal & Yadav (2022) note that privacy concerns related to user data collection must be addressed.

Chatbots

Chatbots are essentially software applications that interact with users in a conversational style. They are computer programs designed to engage users in conversations either through voice or text interactions. They are designed and tailored to perform specific tasks like answering frequently asked questions, providing customer support, or even utilizing a large language model to provide a wider range of assistance to users.

The Library adopts AI-powered Chatbots to cater to users' specific needs by providing real-time support. Kaushal & Yadav (2022) and Barsha & Munshi (2023) note that Chatbots act as virtual assistants, offering 24/7 support by answering queries, guiding database searches, and managing routine tasks such as renewals and reservations.

Beyond these basic functions, Chatbots exceptionally enhance the accessibility of library services by providing continuous access, availability, and ensuring users can always receive assistance outside the normal library hours. As noted by Adetayo (2023), the 24/7 support that libraries offer through the aid of AI-powered Chatbots reduces wait time and enhances user satisfaction. Furthermore, Chatbots automate routine and repetitive tasks, freeing library staff to focus on complex inquiries and personalized services (Oyelude, 2023). This is further proven by Aljanabi et al. (2023), the automation of these library services offers an increase in operational efficiency and resource management.

Another significant importance of Chatbots in libraries is that they offer personalized services. It analyzes user data to provide recommendations on library materials. Mukherjee & Patra (2023) agree that AI Chatbots analyze user behavior to provide tailored recommendations for materials and services, which enhances engagement. Additionally, Chatbots can support multilingual users and those with disabilities, promoting inclusivity in library services (Yan et al., 2023).

Wagwu et al. (2024) also support that data generated from Chatbots can offer valuable insights into user needs and preferences, informing collection development and service improvements. For academic research purposes, Chatbots can also carry out complex research if it was built with a Large Language Model (LLM). Owolabi et al. (2022), Chatbots assist with complex research inquiries, guiding users through database searches and citation management, thus supporting learning and research activities. They also play a role in outreach, increasing engagement with the academic community (Lappalainen & Narayanan, 2023).

However, there are still challenges like incorporating it into existing systems, funding, and a lack of data. Mukherjee & Patra (2023) affirm that integrating Chatbots into existing library systems can be technically complex, and the quality of Chatbot responses is heavily dependent on the data used during its training. Human factors such as staff resistance and concerns about privacy and security also affect adoption rates. Adetayo (2023) also raises concerns about user trust and chatbot capability to handle diverse queries.

Conclusively, AI-powered Chatbots are a powerful tool in the transformation and digitalization efforts of library services. It is a transformative tool in enhancing library services, offering tailored, personalized, and effective support to library patrons while also enabling library staff to be more productive by focusing on pressing tasks.

AI in Digital Preservation and Archiving

Digital archiving and digital preservation are two distinct but intertwined concepts. Digital archiving is the process of collecting, organizing, and storing library materials as digital content to ensure long-term usability and accessibility. Digital archiving primarily focuses on the storage

and retrieval of digital information and involves organizing, classifying, and maintaining digital information for future access. This process encompasses various activities, which include gathering digital materials, evaluating and determining which materials will be preserved, organizing digital materials for access, creating metadata for digital materials, providing access to digital materials, and ensuring long-term access to digital materials. Digital preservation, on the other hand, is a formal procedure that is followed strictly to ensure that digital information can be continuously accessed and used. The Association for Library Collections and Technical Services defines digital preservation as a combination of strategies, policies, and actions that ensure access to digital content over time. Digital preservation ensures that digital collections are not damaged, defaced, or rendered obsolete.

Now, when artificial intelligence is incorporated into this process, it aids the workflow and makes it even easier. AI enhances digital archiving through Optical Character Recognition (OCR), image and text recognition, and automated metadata generation, facilitating preservation and advanced search capabilities (Ali, 2024; Harisanty et al., 2023). AI also supports translation services and content recommendation, expanding accessibility (Suryawanshi, 2024). He further notes that machine translation and transcription technologies powered by AI help convert and organize archived content into multiple languages, making digital collections more inclusive and easier to navigate.

Furthermore, AI-driven technologies make content analysis automated, aid in the intelligent tagging of digital archives, and also offer OCR processing. This helps in the organization of digital archives, especially large archives, and ensures fast, accurate processing and retrieval of digital materials. Terras (2020) affirms that neural networks embedded in AI systems can enhance image quality, detect damage, and classify materials for long-term storage. This is a great addition and innovation to the preservation efforts of librarians.

Ali (2024) highlights that AI applications in academic libraries have improved metadata extraction and content recognition, enabling librarians to index resources more effectively and preserve fragile materials digitally. Similarly, Harisanty et al. (2023) emphasize AI's role in automating routine archival tasks, thus reducing manual effort and improving accuracy. Teel (2024) further argues that AI has the potential to redefine preservation processes by automating indexing and monitoring tasks traditionally performed by humans, although human oversight remains essential to maintain quality and ethical standards. Sadam (2023) also joins to echo the transformation AI has brought in digital archiving and preservation. The author discusses how AI-driven metadata generation and intelligent search capabilities revolutionize data preservation and accessibility in archives.

However, concerns and biases still exist, but it does not override the fact that the integration of AI in archiving and preservation has reduced the enormous workload for librarians, ensuring better preservation and accessibility of materials for long-term use. It has also enhanced efficient and accurate services, thereby ensuring user satisfaction.

Predictive Analytics in Decision-making

Predictive analytics is the use of historical and current data, algorithms, and machine learning techniques to determine possible future outcomes. It identifies patterns in data and uses them to predict future events, outcomes, and trends, which aids in data-driven decision making.

In the library, predictive analytics uses data analysis techniques that include machine learning and statistical modelling to predict future trends, user preferences, and resource recommendations (Jadhav et al., 2024; Bhavsar & Rao, 2024). This approach moves libraries beyond their traditional roles, enabling them to gain valuable insights into patron behavior, usage patterns, and collection trends (Pacific University Library, n.d.).

By utilizing predictive analytics, libraries can make data-driven decisions that improve productivity, efficiency, and user satisfaction (AIJRELPLS, 2024). For example, when circulation records, website traffic, and user demographics are analyzed, it gives librarians insights into what collections are more popular, so they can channel allocations properly by tailoring collections to meet the demands effectively.

Predictive analytics is particularly important in collection development. Data-driven decision making helps libraries acquire relevant materials, weed outdated resources, and allocate budgets effectively (Bhavsar & Rao, 2024).

Predictive analytics also offers personalized recommendations by predicting resource popularity and user needs, thereby enhancing engagement and service relevance (Bhavsar & Rao, 2024). As Jadhav et al. (2024) explain, integrating machine learning algorithms into library systems allows for dynamic adaptation to changing user preferences and emerging research trends.

The integration of big data and machine learning in library analytics is truly transforming library services, enabling libraries to make more informed decisions that are crucial in the development of the library by aiding tailored and improved services as well as enhancing the satisfaction of library patrons.

DISCUSSION

The advent of artificial intelligence brings dynamic and important changes in library operations. AI offers libraries enhanced and all-around productivity. By leveraging AI-powered systems like recommendation systems and Chatbots, libraries can enhance workflow, reduce workload and errors, and ensure tailored services to users, thereby fostering deeper engagement and accessibility by library patrons. AI enables management of growing digital collections and evolving user expectations (Ali, 2024).

There is no doubt that artificial intelligence plays a significant role in the enhancement of library services. The reviewed literature confirms and affirms that AI incorporation in library

services improves access, contributes to operational efficiency, and accuracy. However, challenges and concerns still exist. Some of the persistent challenges include:

- 1. Ethical concerns:** algorithm bias, data privacy, and transparency are the major ethical concerns for AI incorporation. These concerns are not out of place; for instance, machine learning errors can result in algorithm bias, thereby providing unfair outcomes. This kind of outcome cannot be efficient when making data-driven decisions. They may cause discrimination and marginalization. Data privacy and security concerns are also valid. Individuals have the right to determine how their information is collected, accessed, and utilized. This concern often comes up during user tracking and personalization. The extent to which AI uses user data to perform should be analyzed and consented to by the user. Unforeseen circumstances, like hacking, can lead to unauthorized access to user data. These concerns must be addressed to enhance the ethical use of artificial intelligence.
- 2. Funding/Infrastructure Gaps:** AI implementation requires skilled personnel and technological infrastructure to function. Libraries will need to acquire the necessary equipment, train librarians or personnel who will use these systems. This requires huge funding, which many libraries, especially in developing countries, do not have. Moreover, many AI solutions require proprietary software, and libraries need to pay license fees, which makes them dependent on external vendors, engaging in long-term contracts that will put a strain on the library budget, especially libraries with a tight budget. AI systems also have obsolescence risk because there is a rapid technological advancements, which means that hardware and software can easily become outdated, resulting in recurring purchases and debts. Furthermore, to effectively implement AI solutions, high-speed internet connectivity is needed for proper functionality. Some regions do not have access to internet connectivity, talk more about one that is high-speed. Beyond the purchasing of technological infrastructures and training of staff, there are hidden costs like ongoing expenses that the library will continue to incur. AI solutions are not a one-time thing; they require maintenance, cybersecurity protections, and data storage, which are mostly ignored or underestimated by librarians. In all, funding poses a major challenge in the implementation of AI solutions
- 3. Resistance to Change:** initial adoption of AI solutions may face resistance from librarians, especially ones who do not have AI literacy. They will fear that AI will take over their jobs, resulting in a loss of jobs/ unemployment. And even if their jobs are not taken, librarians also feel their profession will be downgraded to just watching machines do their job. That experience of identity loss will make them resist automation efforts. Distrust of AI accuracy, ethical implications, change-fatigue from previous digital advancements, and lack of preparation can bring about skepticism and resistance from staff.

CONCLUSION

Artificial intelligence has come to stay; it is no longer a future concept, and it is a present reality. It is reshaping every sector, and the library cannot be left out. AI automates library services, enhancing and reshaping them by offering tailored services to patrons, ensuring materials are catalogued and classified without errors by creating accurate metadata of materials, enhancing archiving and preservation efforts, as well as offering data-driven insights to aid collection development. AI systems are also a premium asset for the circulation of library materials. AI technologies are offering a well-rounded and developed library ecosystem.

This review aims to point out how important AI adoption is, the continuous training of staff, ethical considerations, and inclusive infrastructure development, by synthesizing existing literature.

Recommendations

1. Ethical concerns should be addressed by developing policies and guidelines that will ensure transparency, fairness, and the privacy and security of data. Loopholes like hacking of systems should also be addressed by technical experts to avoid data theft and breaches.
2. The government should provide adequate funding for libraries to implement these solutions. They can also go into a public-private partnership to achieve this.
3. Library institutions should partner with tech companies to produce tailored AI solutions that meet the library's needs.
4. Institutions should invest in training their staff, especially in AI literacy and technological advancements, to get them prepared ahead of any digital transformations. They should also be well compensated during these periods of transformation.

Suggestions for further research

1. Future studies should investigate how AI models can be adapted in multilingual and low-resource library settings.
2. Examine why AI literacy training among library professionals should be compulsory.
3. How libraries can source and receive funding for AI adoption.
4. How users actually perceive and receive AI library services should be examined.
5. How libraries navigate and bypass ethical implications should also be studied.

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