

APPLICATION OF ARTIFICIAL INTELLIGENCE IN ACADEMIC LIBRARIES: A STUDY

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ABSTRACT

This study investigates the application of Artificial Intelligence (AI) in academic libraries. A thematic analysis identifies AI, machine learning, and chatbots as pivotal areas. The study underscores the interdisciplinary nature of AI research in academic libraries and its growing influence on enhancing library operations, resource discovery and user experiences. The findings provide valuable insights for library professionals and policymakers, enabling more strategic AI adoption to improve efficiency, automate routine tasks. With a research objective to enhance decision-making in library management. AI empowers college libraries to be more agile, user-centric and responsive to the changing academic environment. By embracing AI, libraries can play a pivotal role in advancing digital literacy, enhancing research support and fostering academic success in a data-driven world. Artificial intelligence will greatly improve library operations and services and will upgrade and heighten the relevance of libraries in an ever-changing digital society. Current practices of AI in academic libraries, The Challenges Associated with the Application and Use of AI for Library Services Delivery and Future Research Directions are presented.

Keywords: Artificial Intelligence, Academic Libraries, Current practices, challenges and future of AI in academic libraries ,Library Security, Library Automation, Digital Libraries and Technology.

1.INTRODUCTION

The role of libraries in higher education institutions has evolved significantly with the advancement of technology. Libraries are no longer limited to physical books and periodicals; they have become hubs for digital resources and services. Artificial Intelligence (AI) has emerged as a transformative tool for enhancing library operations, improving security measures, and facilitating automation in library management.

Libraries are increasingly becoming hubs for knowledge access, collaboration, and innovation. However, with these advancements come new challenges, particularly in managing large volumes of information and ensuring the security and accessibility of resources in an ever-expanding digital ecosystem.

AI is being increasingly deployed in varied library settings and applications with both great promise and considerable risks for patrons and staff. Researchers have so far responded to the adoption of AI by libraries by considering the long-term effects or examining specific application areas. Various applications of AI are now available to libraries, such as humanoid greeter robots, software to handle patron requests and automated indexing (Vecera, 2020). The deployment of such AI applications has increased significantly (Lund, 2021), particularly in academic libraries. AI is widely considered one of a few main factors that will change future knowledge management and library work (Bartlett, 2021), even prompting consideration of the future of the library profession within.

The integration of AI in library systems presents an exciting opportunity to address these challenges. AI, which involves the development of computer systems capable of performing tasks that typically require human intelligence, such as problem-solving, pattern recognition, and decision-making, has the potential to revolutionize how libraries operate. AI has significantly transformed the operations of academic libraries, introducing innovative solutions such as automating cataloging, circulation management, enhancing information retrieval, personalizing user experiences, and optimizing resource management (Gabby,2019). In the context of library automation, and resource allocation, enabling library staff to focus on more strategic and creative endeavors. Furthermore, AI can enhance library security through technologies like facial recognition, smart access control systems, and real time surveillance, ensuring that resources are protected while providing a seamless user experience.

These developments have made AI an increasingly important area of study in library and information science. Existing studies often focus on specific AI applications—such as chatbots, machine learning-based recommendations (Ashiq,2024), and automated classification systems—without offering a holistic overview of the research landscape. There is a need for a structured analysis that provides insights into the overall growth and direction of AI research in academic libraries, allowing for a better understanding of its trajectory, challenges, and opportunities (Kennan,2023). While several studies have explored the integration of AI in library services, most have been limited in scope, either analyzing individual case studies or focusing on a narrow set of technologies. As AI continues to advance (Aziz,2024), its integration into academic libraries is expected to reshape information management practices and further enhance the role of these institutions in the digital era (Tai,2020).

The benefits of AI are widely recognized, including enhanced efficiency, increased productivity, improved customer services, informed decision-making, personalized experiences, and reduced risks and errors (Owolabi et al., 2022; Oyetola et al., 2023). Academic libraries, though slower in adopting AI, are gradually catching up (Oladokun et al., 2023). There is also significant potential for AI in academic libraries to improve user experiences, streamline operations, and enhance access to information in innovative ways (Nehra & Bansode, 2024). AI is increasingly shaping the future of academic libraries, offering new opportunities for automation, personalization and data-driven decision-making. This study contributes to a more structured understanding of AI's impact on library science, informing future research and practice in this evolving field.

2. RESEARCH OBJECTIVES

The study is a systematic literature review on the adoption of AI in academic libraries, focusing on current practices, challenges, and future directions. Discussing the three research objectives of the study and the findings, the researchers contribute to the overall literature on the adoption of AI in academic libraries:

0. The current practices of AI in Academic libraries in the literature.
1. Types of academic library challenges of AI have been reported in the literature.
2. The future research directions related to AI in academic libraries as reported in the literature.

This study contributes to the academic and professional understanding of AI's role in academic libraries by offering a systematic overview of research developments. The study provides quantitative insights into how AI research has evolved in this field, allowing

researchers, librarians, and policymakers to make informed decisions regarding AI adoption and implementation. This study also helps bridge the gap between technological advancements and their practical applications in library management.

3. SCOPE AND LIMITATIONS

This study specifically examines AI applications in academic libraries, rather than extending the analysis to other library types. The rationale for this focus is based on the unique functions and technological needs of academic libraries, which differ significantly from those of other library types. Academic libraries serve as knowledge hubs for higher education and research institutions, offering a diverse range of digital resources, research support services, information literacy, and digital knowledge management and AI-driven discovery systems (Wheatley,2021).

4. REVIEW OF LITERATURE

Libraries are starting to use AI; they need to produce new ways of working with information. This means that librarians need to be able to understand and work with data and algorithms. To deal with the problems of too much information and people not having access to it, the authors suggest creating an “Intelligent Library” that uses AI and other advanced technologies to make it easier for people to find the information they need.

4.1 Evolution of AI in Academic Libraries:

AI adoption in academic libraries has evolved from basic automation tools to advanced applications such as machine learning, natural language processing, and intelligent recommendation systems. Traditional library services primarily relied on manual cataloging and reference management. However, the advent of digital libraries facilitated the integration of AI-driven tools for resource management and information retrieval (Javaid,2022). These developments underscore AI’s growing role in enhancing the accessibility and usability of academic library resources.

4.2 Key AI Applications in Academic Libraries

Recent studies have explored various AI implementations in libraries, including automated indexing, sentiment analysis, and predictive analytics (Huang,2023). AI-powered chatbots and virtual assistants now support library users by providing instant responses to inquiries, improving service efficiency (Necula,2023).

4.2.1 AI in Information Retrieval and Knowledge Discovery

AI-driven search engines and recommendation systems have revolutionized information retrieval in academic libraries. Machine learning algorithms enhance metadata indexing, enabling users to locate relevant resources efficiently (Zhang,2021). Studies indicate that AI-based knowledge mapping tools significantly improve research navigation by clustering related topics (Omame,2020).

4.2.2 Chatbots and Virtual Assistants of AI in Libraries

Libraries have increasingly implemented AI chatbots to handle routine queries, reducing the workload on librarians and improving response times (Huang,2023). Research by Cox and Mazumdar emphasizes the effectiveness of AI chatbots in enhancing user engagement and personalization. However, challenges such as ethical concerns and biases in AI driven recommendations remain areas of ongoing research (Kooli,2023).

4.3 AI in Collection Management and Decision-Making

AI applications in library collection management include predictive analytics for book acquisitions and usage pattern analysis (Dwivedi,2023). AI algorithms assess user preferences and borrowing behaviors, guiding libraries in optimizing resource allocation (Arantes,2021). Additionally, AI assists in digital preservation efforts, ensuring long-term accessibility of academic resources.

4.4 Ethical Principles and Practices of AI in Libraries

Although AI offers significant advantages in library operations, it also raises ethical and technical concerns. The ethical implications of AI in the library profession are well documented. AI generated metadata and recommendation systems may introduce biases, affecting information accessibility. Moreover, privacy concerns related to AI-driven user data analytics necessitate strict data protection policies (Wusu,2024).

The digital divide is another critical challenge, as AI adoption varies across regions due to differences in technological infrastructure and expertise (Gozali,2024). Addressing these disparities requires targeted training programs and policy interventions to ensure equitable AI integration in academic libraries.

Core librarian values such as academic integrity, privacy, intellectual freedom, neutrality, and transparency face potential compromise through AI technologies (Huang et al., 2023). Research by Subaveerapandiyan (2023) in Zambia and Gujral, Shivarama, and Choukimath (2019) in India shows that concerns over privacy and intellectual freedom are key barriers to AI adoption in academic libraries.

4.5 AI Competencies and Related Skills

The adoption and use of artificial intelligence require highly specialized and skilled human capital. According to Alekseeva et al. (2021), the demand for AI-related skills has surged in recent years, particularly in the information sector. As key information hubs, academic libraries must develop AI competencies and relevant skills to effectively meet their core responsibilities in an AI-driven environment. One challenge identified in this review is the scarcity of librarians with the necessary AI skills and expertise. This issue of limited AI expertise has persisted in libraries for over three decades. Researcher noted that a lack of AI experts in the library field and minimal training in AI techniques were major barriers to adoption.

4.6 Knowledge and Education about AI

Current Knowledge and education are essential for fostering innovation within organizations, including academic libraries. However, the level of knowledge and education about AI in these libraries is generally considered low, a challenge that has been reported worldwide.

A study by Huang et al. (2023) involving the top 25 universities in the United Kingdom and Mainland China found that librarians' understanding of AI is a crucial factor in its adoption and use. Similarly, Hervieux and Wheatley (2021) highlighted that librarians in the USA and Canada recognize the importance of investing in AI knowledge and education to ensure successful implementation in academic libraries.

In the UK, technical barriers related to AI adoption have also been observed, with Huang et al. (2023) noting a lack of technical support teams in libraries. This issue is echoed in studies from developing countries and North America, where researchers like Andrews et al. (2021) and Aslim et al. (2023) identified training gaps, limited knowledge, and talent shortages as

major obstacles to AI adoption in academic libraries. To address these challenges, it is essential to improve AI knowledge and provide librarians with the necessary education to effectively operate in an AI-driven environment.

5. CURRENT PRACTICES OF AI IN ACADEMIC LIBRARIES

Librarians and AI are increasingly intertwined in the educational landscape. Here are some key aspects of their relationship:

0. Technical services

Automation; Indexing; Catalogue/ cataloguing service; Classification; Acquisition; Intelligent content extraction and curation; Curation of rare resources and AI meta generation.

1. References and information services

Answering directional and ready reference questions; Helping users to locate books; Discovery systems; Web search optimization; Information and library search; Recommending materials to patrons; Information service; AI for Selective Dissemination of Information (SDI); Chat transcription and expedited reference services; Personalization of learning resources; Retrieve academic materials faster and predict future resource needs.

2. Administrative services and circulation

Self-check-out machine for books; Handling complex tasks; Circulation services; Intelligence acquisition; Used as a marketing tool for the library; Expedite decision-making processes; Replace time- consuming tasks; A tool for statistics evaluation and recommendations; Enhancing library service efficiency; Enhance user- centric service; Facial recognition for access; Alleviate the burden of routine administrative tasks for University Librarians; Security and privacy of users' data; RFID for self-check- in/out and security; Manage workload efficiently; Help librarians analyze usage patterns and resource preferences; Assisting in the charging and discharging of library materials.

3. Collection Development

Collection development; Quick and instant support for librarians to users' queries; Use of intelligent virtual agents and User authentication.

4. Information Literacy and User Education

Teaching and advocating cautious and reflective adoption of AI technologies in libraries; Library-hosted AI events; Guide users to retrieve relevant resources; Promotion, orientation and training.

5. Professional Development and Collaboration

Professional development by providing unique trends in research in LIS; Establish collaboration by sharing platforms and repositories with librarians.

6. THE BENEFITS OF APPLICATION AND USE OF AI FOR LIBRARY SERVICES DELIVERY

Use of AI is capable of doing the job faster than a human; Application of AI reduces human error and defects; Use of AI makes it easy to do complex work without stress; AI is capable to explore things which are in outer space; Use of AI prevent repetitive tasks; Use of AI

creates opportunities for library users; AI makes information accessible to users without stress; AI is very flexible and user friendly; AI allows for virtual library services and AI makes retrieval of information easy.

7. THE CHALLENGES ASSOCIATED WITH THE APPLICATION AND USE OF AI FOR LIBRARY SERVICES DELIVERY.

The challenges faced in implementing artificial intelligence (AI) in both significant potentials to improve library operations, barriers such as technical, financial constraints, lack of technical expertise, and concerns over data privacy and security hinder its full adoption. To address these issues, this study examines the innovations, challenges, and impacts of AI implementation in library services.

1. Technical challenges

Technical skill and knowledge gap

2. Limited IT skills and expertise among librarians

Lack of complete knowledge and instruction of AI and Integration of AI into an existing system.

3. Data quality

Hallucination - inaccurate or confusing bot responses; Insufficient datasets and deficiencies in the quality of bibliographic data and Institutional challenges.

4. Finance

Funding and Cost of Technology.

5. Institutional infrastructural issue

Limited power supply; Poor networking; Outdated technologies; Inadequate infrastructure and Lack of full-fledged AI tools.

1. Ethical concerns

AI ethics - academic integrity, biased and false information, intellectual property and plagiarism, Copyright issues, Privacy concerns, Cybersecurity and Ethical concerns.

2. Organizational issues

Organizational technological practices; Lack of institutional policy; High authority support; leadership/management adaptation; Inequality in library development; Lack of human-AI integration and Environmental Challenges.

3. External Issues

Robot uprising; Misleading public understanding of AI capabilities; Governance disparities globally and Exposure to International Standards.

4. Individual Challenges Competences

Lack of confidence in new technology; An increase in the margin of error resulting from excessive automation; Over-reliance on AI; Over-trusting AI outputs due to anthropomorphic language and Librarian preparedness.

5. Individual fears and concerns

Fear of job loss; Job insecurity concerns; Resistance to change; Traumatization of librarians; Redundancy of librarians' role; Negative perception from librarians and Risk aversion.

8. PRACTICAL RECOMMENDATIONS FOR AI IMPLEMENTATION IN LIBRARIES

To maximize the benefits of AI while mitigating associated challenges, academic libraries should adopt strategic approaches to AI integration.

1. Developing AI literacy programs for librarians is essential. Training initiatives should focus on machine learning fundamentals, AI ethics and hands-on experience with AI-driven library tools (Alam,2024).
2. Collaboration with universities offering AI-focused courses in Library and Information Science (LIS) could ensure that future librarians are equipped with AI competencies from the outset.
3. Enhancing AI-driven information discovery systems should be a priority. Libraries should invest in natural language processing-based search engines that allow users to conduct more intuitive searches, similar to commercial platforms like Google and Amazon.
4. Implementing personalized recommendation systems, driven by AI-powered user behavior analytics, can improve resource visibility and engagement.
5. AI-enabled semantic search tools can also assist researchers in identifying relevant literature, related concepts and interdisciplinary connections more effectively.
6. Ensuring ethical AI usage in libraries is crucial. AI-driven decision-making should be guided by ethical AI frame works that emphasize transparency, accountability and fairness.
7. Libraries should establish AI ethics committees to oversee algorithmic decision-making, ensuring that bias detection and fairness assessments are conducted regularly.
8. Open-source AI tools should be promoted to enhance transparency and prevent reliance on proprietary AI systems that lack interpretability.
9. Promoting cross-institutional AI research collaborations will strengthen knowledge sharing and accelerate AI driven innovations in library science.
10. Universities and libraries should pursue joint research grants, enabling collaborative development of AI tools and best practices for library management.
11. Establishing regional AI research hubs can further facilitate interdisciplinary partnerships between computer scientists, data analysts, and library professionals, fostering innovative AI applications tailored to academic libraries' unique needs.

By adopting these practical recommendations, libraries can harness the full potential of AI to enhance research capabilities, streamline operations, and provide more personalized user experiences while addressing ethical and technical challenges.

9. FUTURE RESEARCH DIRECTIONS

While AI has made significant strides in academic libraries, several areas remain underexplored, presenting opportunities for future research.

AI for digital inclusion and accessibility.

1. AI can be leveraged to enhance library services for visually impaired, hearing-impaired, and neurodiverse users.
2. AI-driven speech-to-text conversion, real-time sign language translation and AI-powered reading assistants could bridge accessibility gaps, ensuring that library resources are available to all users.
3. AI in library decision-making and collection management.
4. Research could explore how predictive analytics can optimize book acquisitions, budget allocations and space utilization in academic libraries.
5. Machine learning models could also be used to forecast research trends, allowing libraries to curate collections proactively based on emerging academic interests.
6. AI and user behavior analytics is another area that requires further exploration. Understanding how students and researchers interact with AI-driven library services can provide insights into improving engagement strategies and user satisfaction.
7. AI algorithms adapt to user preferences over time, ensuring that recommendation systems remain relevant and effective.
8. Ethical and regulatory challenges surrounding AI in libraries also warrant deeper investigation. While some research has addressed AI biases and privacy concerns, comparative studies examining AI regulations in different regions could offer insights into best practices for ethical AI governance in library settings.
9. Examining how different countries are tackling AI transparency, user consent, and data protection could inform global AI policies for academic libraries.
10. Future bibliometric analyses should measure AI's long-term impact on academic libraries.
11. AI adoption influences library performance, research productivity, and student outcomes over extended periods.
12. Longitudinal studies could track how AI-driven services evolve and assess their effectiveness in enhancing research support, academic integrity, and institutional knowledge management.
13. The long-term impact of AI integration on library services.
14. Exploring advanced AI technologies such as machine learning and natural language processing in library automation.
15. Expanding the study to include libraries in other regions or countries to compare global trends.

By addressing these future research directions, academic libraries can ensure that AI technologies are not only efficiently implemented but also continuously improved, fostering a more inclusive, ethical, and innovative research environment.

10. SUGGESTIONS AND RECOMMENDATIONS

1. Government Support: The government should provide funding and resources to support the integration of AI in libraries.
2. Training Programs: Institutions should focus on training library staff and faculty on AI technologies and their applications.
3. Collaboration with Tech Companies: Universities should collaborate with technology firms to ensure that AI solutions are tailored to the specific needs of their libraries.

CONCLUSION

The study identifies key areas of AI application, including machine learning, chatbots, data mining, and intelligent library systems. Furthermore, by assessing the ethical and practical challenges of AI integration, this study bridges the gap between theoretical research and real-world implementation, making it highly relevant for both academia and library practitioners. Future studies should consider a multi-database approach to provide a more comprehensive representation of AI research in academic libraries.

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