

The Integration of Artificial Intelligence into Library Services

Duong Thi Phuong Chi*

Abstract

Artificial Intelligence (hereafter “AI”) is one of the latest technologies being incorporated into library services. This paper uses qualitative content analysis of existing literature to explore the prospects and challenges of AI adoption in libraries. The findings show that AI significantly enhances both technical and public services by improving efficiency, personalisation and accessibility. However, the adoption of AI also raises concerns, including data privacy and security, algorithmic bias, limited AI literacy among librarians and high implementation costs. Effectively addressing these challenges will enable libraries to better meet user needs and improve their services.

Keywords: Artificial Intelligence, Digital Transformation, Technological Adaptation, Library Services, Digital Libraries

user experience and stay competitive in the digital age. AI in libraries enables users to explore knowledge more efficiently through personalised recommendations. However, the use and understanding of AI in library services still raises many concerns. Therefore, this paper aims to explore the opportunities and challenges of integrating AI into library services to better leverage this new technology. It applies qualitative content analysis to investigate existing literature on how AI adoption promotes innovative services in libraries. Data were collected through a systematic review of journal articles, with Google Scholar as the primary search engine. Relevant literature was identified using keywords such as AI, machine learning, natural language processing, data mining, library services and several other related search terms. This paper provides librarians with insights into the adoption of technology in library services, enabling them to leverage AI for digital transformation and gain a competitive advantage in the fourth industrial revolution.

Introduction

Artificial Intelligence (AI) is the most discussed technology of the current decade because of its ability to mimic human intelligence. Artificial Intelligence (AI) can perform complex cognitive processes, including learning, perception and language understanding, as well as problem-solving. With the help of artificial intelligence (AI), the software or processes developed can solve real-world problems with greater accuracy and speed. As a result, AI is playing an important role in many aspects of everyday life.

Libraries, which have long served as repositories of knowledge, have recently transformed their services and operations through the integration of AI. Libraries are adopting AI to enhance service quality, improve

Overview of Artificial Intelligence

The term ‘AI’ was first coined by John McCarthy and his colleagues at a conference held at Dartmouth College in the United States in 1956 (Zawacki-Richter et al., 2019). AI is difficult to define clearly because it is an imitation or simulation of something that we ourselves do not fully understand: human intelligence (Sheikh, Prins & Schrijvers, 2023). Baker and Smith (2019) describe AI as computers performing cognitive tasks such as learning and problem solving. They describe AI as a broad term that encompasses many different technologies, including machine learning, natural language processing, data mining, neural networks and algorithms. Kaplan and Haenlein (2019) specifically define AI as a system’s ability to correctly interpret external data, to learn from such data

* University of Social Sciences and Humanities, Ho Chi Minh City, Vietnam; Vietnam National University, Ho Chi Minh City, Vietnam. Email: duongchi@hcmussh.edu.vn

and to use those learnings to achieve specific goals and tasks through flexible adaptation. Many innovative AI technologies are designed to simulate human cognitive abilities so they can handle more complex problems in a purposeful, intelligent and adaptive manner. AI is often seen as a combination of machine learning and data analytics, although it extends beyond these fields.

Fundamentally, AI operates based on four core principles, including data collection, data processing and learning, modelling and prediction and feedback-driven improvement. It can be classified based on its operational mechanisms and levels of intelligence. Traditional AI includes rule-based systems, machine learning and deep learning, which evolve from manually programmed logic to data-driven learning using neural networks. More recently, generative AI has emerged as a powerful branch capable of generating new content based on learnt data patterns (Dua & Patel, 2024).

AI became popular in the 2010s due to big data availability, improved machine learning algorithms and the affordability of cloud and high-performance computing systems (Hirsch-Kreinsen, 2024). Notably, the launch of ChatGPT marks a breakthrough in AI development in the field of natural language processing. ChatGPT utilises deep learning algorithms capable of generating responses, translating text and writing on various topics. It quickly became the fastest-growing AI tool after its launch in late 2022 (Zamfiroiu, Vasile & Savu, 2023).

Currently, AI is used in many fields such as medicine, business, education, gaming, libraries, etc. The development of AI in libraries has made significant progress, reshaping the way libraries operate and support users. The potential for integrating AI in traditional and digital libraries is huge. However, as AI becomes more prevalent, libraries must understand the pros and cons associated with these technologies.

Potential for Using Artificial Intelligence in Library Services

Research on AI in libraries has grown in recent years, with previous studies focusing on librarians' perceptions of emerging technologies such as the Internet of Things and AI-based systems. Overall, librarians expressed

positive views, recognised the potential of AI to transform library functions and showed interest in relevant training (Hervieux & Wheatley, 2021; Yoon, Andrews & Ward, 2022). Other studies explore the trends for future use of AI in libraries. Cox and Mazumdar (2022) identified five distinct types of use cases of AI, including applications in library back-end processes, in library services, through the creation of communities of data scientists, in data and AI literacy and in user management.

AI can enhance various library services, which encompass both technical and public functions. These include the provision and organisation of information resources (e.g., classification, indexing and abstracting); storage and retrieval of information; circulation; reference services; interlibrary loans and research support (Asemi, Ko & Nowkarizi, 2021). However, the successful adoption of AI remains debatable due to the lack of research on its application in libraries, especially in the context of practical implementation (Harisanty et al., 2023). This paper provides details on the implementation of AI in both library technical and public services.

Artificial Intelligence in Technical Services

Technical services are library operations concerned with the acquisition, cataloguing, physical processing and maintenance of library collections (Reitz, 2017), with cataloguing being one of the most challenging and time-consuming aspects. This process includes creating bibliographic descriptions, conducting subject analysis and assigning classification notation, all of which are necessary for the efficient organisation and retrieval of library materials. These tasks are usually performed under the supervision of trained librarians such as cataloguers. Cataloguers must quickly understand the content of resources and apply complex systems such as Library of Congress Subject Headings (LCSH), Library of Congress Classification (LCC) and Dewey Decimal Classification (DDC), which require extensive study and practice.

AI technologies, particularly machine learning and natural language processing, have the potential to improve the efficiency, consistency and depth of metadata creation and classification, ensuring more accurate and reliable document indexing. Natural language processing,

which aims to help computers understand and process human language, is particularly effective at automating tasks such as text analysis, information extraction and summarisation. By using natural language processing algorithms, libraries can automatically extract key information from library collections, identify related concepts and generate summaries, making it easier for users to quickly retrieve information. Tools like OpenAI's ChatGPT, Google's Gemini and Microsoft's Copilot, which use large language models to understand and generate text, can assist in producing appropriate LCSH, LCC and DDC headings and numbers, thereby streamlining the cataloguing process and improving accessibility of library materials.

In addition, AI applications provide opportunities to assist in data acquisition to serve the user community better. AI-powered crawlers use machine learning and natural language processing to interpret context and prioritise relevant content accordingly. These tools are especially useful for librarians when collecting data by scanning scholarly databases and open access repositories, as well as online publications, to find valuable resources. Additionally, data mining analyses large data sets to discover patterns, relationships and trends that can help libraries understand user behaviour, usage patterns and citation networks. These insights support better decision-making in collection development, ensuring that library materials effectively meet user information needs.

These advances have far-reaching implications for how libraries operate. Routine tasks like cataloguing and metadata creation will increasingly be managed by AI, allowing librarians to spend more time on high-impact areas like research support, educational programming and community partnership building.

Artificial Intelligence in Public Services

Public services are library activities and operations that bring staff into regular direct contact with users, including circulation, reference, online services, bibliographic instruction, serials assistance, government documents and document delivery (Reitz, 2017). This paper considers how AI is changing the way libraries provide reference services and online support in particular.

Traditionally, library users seeking assistance in finding information or using resources would visit a reference desk, call, or email and a reference librarian would then provide them with an answer or refer the inquirer to a knowledgeable source. With advances in machine learning and natural language processing, AI-powered chatbots now provide a reliable solution for libraries to enhance reference services through virtual assistance. These chatbots, like ChatGPT, can be integrated into library websites to provide instant responses to frequently asked questions like general information and library policies, freeing librarians to handle more complex enquiries. AI-powered chatbots ensure convenient and accessible services outside of regular library hours, responding to users in a timely and accurate manner. Furthermore, advances in natural language processing can handle a broader range of questions, including support for multiple languages, thereby making library services more accessible to a diverse user base. A study by Panda and Chakravarty (2022) on the integration of intelligent AI chatbots into library services highlighted their effectiveness in implementing virtual assistance, enhancing reference services and promoting the concept of "libraries without walls".

The distribution of information and resources has always been a primary focus of libraries. With the development of digital technology, the way users search for and use information has changed, requiring libraries to adapt their services. As information seekers, library users must be able to locate relevant resources among vast collections efficiently (Gasparini & Kautonen, 2022). Libraries serve as repositories of knowledge, but the sheer volume of material can make it difficult to find specific, useful content. Libraries serve as a repository of resources for users to conduct research and gather information, but the sheer volume of materials can overwhelm users as they try to find specific, relevant materials within a massive collection. To address this challenge, recommender systems analyse large datasets using machine learning and data mining techniques to recommend relevant and potentially useful items to users. Machine learning, which allows computers to learn from data and make informed predictions and decisions, enhances library operations by advancing information retrieval, recommendation systems and predictive analytics. For example, machine learning algorithms can learn from user behaviour to

provide personalised recommendations for relevant books, articles, or related resources, enhancing the user experience and increasing the chances of discovering relevant information. These not only increase user satisfaction but also enhance user engagement with library services.

In addition to recommender systems, AI-powered tools like web crawlers, chatbots (Panda & Kaur, 2023) and image recognition technology will streamline data collection and retrieval, making these processes faster and more efficient. By anticipating user needs, AI will help libraries deliver more relevant content, strengthening the relationship between users and library resources.

Furthermore, AI plays a significant role in improving accessibility within libraries. Technologies such as speech-to-text, text-to-speech and real-time translation enhance inclusion, ensuring that users with diverse needs can fully participate in library resources and services. By integrating these features, libraries can provide equal access to information for people with disabilities or limited language proficiency, consistent with the library's mission to serve as a community resource for all (Okwu, Oyighan & Oladokun, 2024).

Inamdar (2023) found that artificial intelligence text generators (AITGs) can help libraries streamline operations, enhance services and improve access to collections, especially in virtual environments. More broadly, AI is transforming digital library services by enabling seamless access to resources regardless of location. Through virtual platforms and AI-based tools, libraries can overcome physical barriers, expanding their reach to more users.

Challenges of Using Artificial Intelligence in Libraries

While using AI in libraries can bring many benefits, it also poses challenges that need to be considered. These include concerns related to data privacy and security, issues of bias and fairness, limited AI literacy among librarians and high implementation costs.

The main concerns when adopting AI technologies are privacy and data security. Libraries collect user information, including personal details, book-borrowing history and search history, which AI systems use to provide personalised recommendations and improve user experience. Therefore, using AI to analyse such information raises important questions regarding data storage, processing and protection. To ensure data protection, libraries must comply with relevant privacy regulations and obtain explicit consent from users before using personal data.

Bias and fairness in AI algorithms is another important challenge that needs to be addressed. Because AI systems learn from existing data, they can inherit biases that lead to unfair outcomes. For example, ChatGPT can answer basic reference questions. However, there is a risk of inaccurate responses due to limitations in comprehension and input restrictions, so it should serve as a supplement rather than a replacement for human librarians (Adetayo, 2023). Therefore, libraries and AI developers must collaborate in designing and training their AI systems to be unbiased, fair and inclusive.

Lack of AI literacy is a challenge in integrating AI into library operations. Although librarians have shown interest in AI, currently, little to no programming training is offered in libraries (Hervieux & Wheatley, 2021). As AI becomes more and more integrated into library systems, the role of the librarian is expected to evolve significantly. They will need to acquire new skill sets and deepen their understanding of AI technologies to manage these tools effectively. To prepare for AI adoption, librarians should attend conferences and training programmes to develop the necessary competencies.

In addition to skill-related barriers, high initial costs are a major barrier to implementing AI in libraries. The lack of necessary physical equipment and reliance on proprietary AI software make integration even more difficult (Akinyemi, 2023).

Taken together, these challenges highlight the need for libraries to carefully plan and deploy AI technologies while taking into account limitations in data management

policies, bias and fairness, librarian capacity and financial resources.

Conclusion

In the digital age, libraries face the challenge of effectively managing large data collections and providing users with relevant information. The rapid development of AI offers opportunities to enhance library services, especially in areas such as acquisition, cataloguing, reference services and online support. However, alongside these opportunities come significant challenges, including concerns about data privacy and security, algorithmic bias and fairness, limited AI literacy and high implementation costs. Addressing these challenges requires strategic planning, investment in librarian training and compliance with ethical and legal issues. As AI continues to evolve, libraries must proactively adapt to ensure they can leverage its full potential while minimising the associated risks. By doing so, libraries can not only improve operational efficiency and user experience, but also enhance their relevance and value in a rapidly changing information society.

Conflict of Interest

The author declares no conflicts of interest.

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