

Application of Artificial Intelligence in Libraries: Benefits and Drawbacks

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ABSTRACT

Artificial Intelligence is revolutionising the different areas of life and libraries and information centres are no exceptions. Many libraries are now looking for new ways to improve their services, enhance library activities and meet the changing needs of their patrons. Artificial Intelligence or Machine Learning can help achieve these objectives. This article talks about Artificial Intelligence and its major components and presents a review of literature trying to determine what is happening in this domain. It further discusses AI applications in different areas of library information services, especially cataloguing, acquisition, reference services, circulation, indexing, robotics, etc. It further compares the benefits Vs drawbacks, as nothing comes without limitations or challenges. This basic exploration of AI applications in libraries could benefit a beginner or someone who has just started exploring the same.

Keywords: AI in libraries, Machine learning, Large Language Models, Robotics in libraries, Natural language processing, Expert systems, Automation in library operations, Human Intelligence.

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INTRODUCTION

The emergence of Artificial Intelligence (AI) in recent years has had a significant impact on many industries, from the healthcare and financial sectors to education and the entertainment industry. AI is shaking up how we do things and opening up new opportunities. Libraries are no exception, as they have long been a vital source of knowledge and resources for communities and students, as well as for researchers and faculty. However, with the emergence of AI, many libraries are now looking for new ways to improve their services, enhance library activities and meet the changing needs of their patrons. AI, particularly in the library sector, encompasses a broad array of applications that use machine learning, Natural Language Processes, Current Visions, Expert Systems and analytics to enhance access to data, automate mundane tasks and improve user experiences. Integrating AI into library operations significantly transforms how libraries operate and interact with patrons. As libraries work to stay relevant and evolve with the times, AI can help streamline resource management, make information more discoverable and engage with users in new ways. But, like any technology, implementing

AI in a library requires careful planning, cooperation and a dedication to preserving the fundamental principles of accessibility, fairness and intellectual liberty that have defined library services for centuries.

ARTIFICIAL INTELLIGENCE

AI is the process of facsimileing human intelligence in a computer or other machine. It involves the creation of algorithms and software to enable machines to carry out activities that typically require human intelligence. These activities may include problem-solving, learning, thinking, perception, comprehension of natural language and environmental manipulation. AI systems can analyse data, recognise patterns, make decisions and adapt to changing conditions, often aiming to optimise their future performance. AI is a wide-ranging field with various sub-disciplines, such as Machine Learning, Natural Language Processing, Computer Vision, Robotics and others, each focusing on particular aspects of AI in machines.

AI is a field of research that has its roots in the concept of creating artificial intelligence with human-like capabilities. Ancient mythology and philosophical writings often refer to automata or intelligent machines. The field of AI was formally established in 1956 at the Dartmouth Workshop, when the concept of AI was first proposed by John McCarthy and Marvin Minsky, with the help of Nathaniel Rochester and Claude Shannon. He proposed that "every aspect of learning or any other characteristic of



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intelligence can be described theoretically so precisely that a machine can be built to simulate it."

The High-Level Expert Group (HLEG) defines "Artificial Intelligence" ("AI") as "a human-designed software and hardware system that, in the context of a complex objective, performs physical or digital operations by perceiving its environment through the acquisition of data, interpreting the data collected, whether structured or non-structured, reasoning on that knowledge, processing the information derived from that data and deciding on the most appropriate action to take to accomplish that objective." AI systems can use symbolic rules, or learn a numerical model. They can also change their behaviour by examining how the environment reacts to their previous actions.

AI technology is composed of a variety of techniques and methodologies (Figure 1)

Machine Learning (ML) is the subset of AI, which involves the training of algorithms to generate predictions or decisions without the need for explicit programming.

Deep learning is a subset of ML, which involves the use of neural networks and decision trees, as well as support vector machines.

Reinforcement Learning is a form of ML that involves the training of agents to make decisions based on their interactions with an environment.

NLP, on the other hand, involves the understanding, interpretation and generation of human language through the use of computers.

Computer Vision is the field of AI that deals with interpreting and understanding visual information from the environment, such as images, videos and more.

AI is widely used in robotics to allow machines to carry out tasks independently or partially.

REVIEW OF LITERATURE

Several studies have been conducted and it is understandable that due to rapid changes in society regarding information explosion, libraries started assimilating with AI while it is used in every aspect of life.

Banerjee (2023), in his paper, explains as what artificial intelligence is and how it can be useful for libraries. He also discusses the advantages and disadvantages of AI. His research proves the feasibility of using artificial intelligence as a professional system for acquiring, indexing and reference services.

Barki (2022), discussed the potential for expert systems to provide reference services, robots to conduct book research and shelf analysis and virtual reality to facilitate deeper learning. Despite incorporating artificial intelligence into libraries, it may appear to alienate library staff from their users. However, it will likely help libraries become larger than simply taking on the librarian role. This will improve the delivery of their offering. Artificial intelligence will be present in the form of library operations and services, which can significantly enhance and strengthen the importance of libraries in a rapidly evolving virtual society.

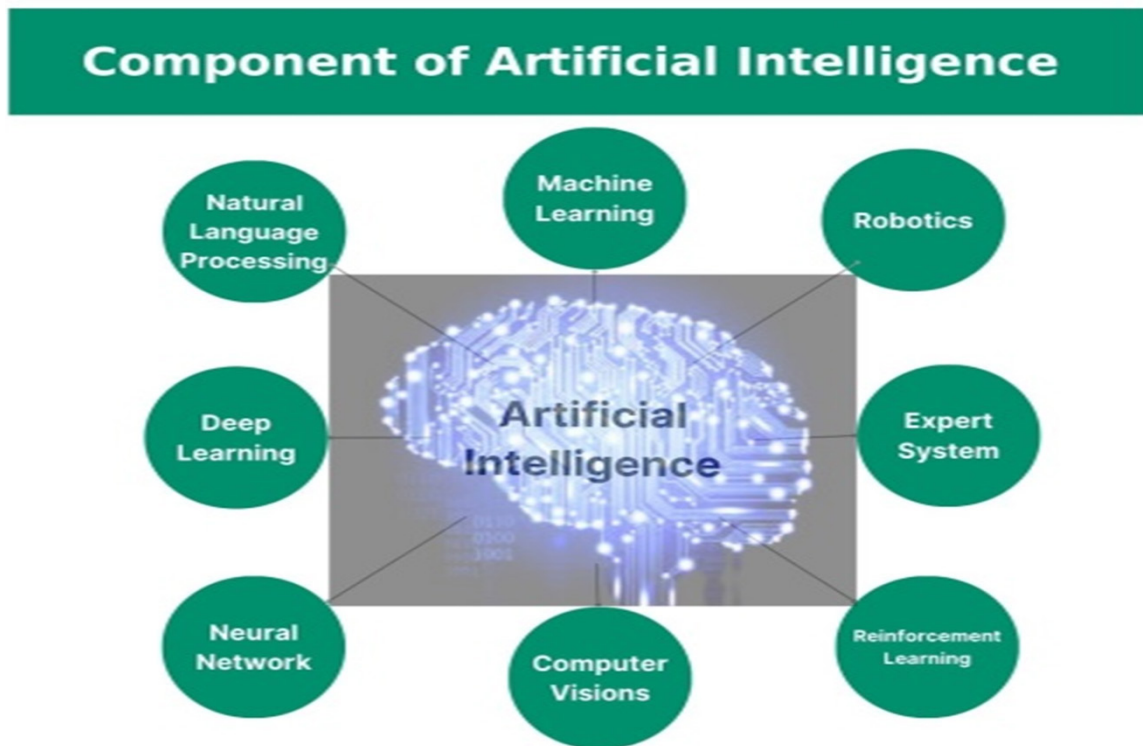


Figure 1: Components of AI.

In their paper, Cox, *et al.* (2018), examined how AI might affect academic libraries and what it could mean for their work. They talked to 33 people, including library directors, commentators and education and publishing experts and they found that AI could significantly impact search, resource discovery, scholarly publishing and learning. They also found that libraries were left out of development, there were ethical issues, it was easy to make decisions and the data quality was good. Some people even thought it could put them out of work. They found that academic libraries could do a bunch of different things, like getting data, curating, buying AI tools, building infrastructure, helping people navigate and making sure people understood the data. Basically, they said that libraries need AI systems.

Arora (2020), in her research, found that AI in libraries is still in its early stages. AI has a lot of uses that will help users with their information needs. To set up robust systems, you need to use AI software, big data, databases, their integration interfaces, storage, communications and network technology. Libraries and information professionals can use existing systems like Chatbots, Google's Cloud 9 Vision, Amazon's Recognitions and OpenCV to help their users.

Liu (2022), researched using AI in information retrieval in academic libraries. This study aimed to identify the weaknesses of the current intelligent information retrieval system. The study found that the main problems with AI information retrieval technology in academic libraries are a lack of natural language knowledge, unclear knowledge representation and difficulty accessing knowledge. Researchers have proposed new ways to overcome these problems, based on new developments in AI technology. AI and information retrieval have significantly improved overall management capabilities and the university's user experience. The analysis showed that it is necessary to strengthen AI technology in order to use its full potential in bringing back information to educational institutions. AI is pivotal in improving information retrieval capabilities, providing personalised services and integrating multiple retrieval methods into a digital library environment.

Application of AI in Libraries

AI has a wide range of applications in libraries, transforming how libraries manage their collections, interact with patrons and provide services. Some of the critical applications of AI in libraries include:

AI in cataloguing

AI cataloguing applications have revolutionised how libraries manage and organise their collections. AI can automatically create metadata for library materials by extracting information from various sources, such as the material's title, the author, the publication data and the content itself. NLP (Natural Language

Processing) techniques are often used to analyse and understand text.

AI can help cataloguers classify materials and assign appropriate subject headings.

It can suggest appropriate subject headings and classification codes, based on the material's content and context.

AI can help cataloguers maintain authority control by suggesting authorised forms of the author name, subject name and corporate name.

It can identify and flag inconsistencies or variations in the names and subject headings.

AI can perform quality control checks on catalogue records to detect errors, inconsistencies or missing information, ensuring the accuracy and reliability of the catalogue database.

It can help with multilingual cataloguing in libraries where collections are available in multiple languages.

AI can help to translate and transliterate metadata to make material more accessible to a broader audience.

It can help with record duplication and merge cataloguing records for a cleaner and more effective catalogue database.

AI can analyse metadata records and enrich them with semantic information such as related terms, synonyms and links between terms to help users find relevant materials.

It can also help to integrate linked data concepts in cataloguing practices so that library resources can better connect with external datasets, e.g. authority files, linked open data, etc.

AI can use pattern recognition to automatically group related items or identify works that belong to a series.

It can generate short summaries of long materials to help users understand the relevance of a resource.

AI and Machine Learning can be employed in cataloguing to enhance the accuracy and efficiency of cataloguing information and provide users with recommendations and reviews.

AI in acquisition

AI applications can be used to automate decision-making processes related to the use of MARC fields, which can help cataloguers adhere to catalogue rules and standards. By utilising AI and ML in cataloguing, libraries can streamline the discovery and access of materials in their collection, allowing staff to focus more on more complex tasks and patrons to receive better service. Nevertheless, it is essential to regularly update and improve AI systems to remain up-to-date with changes in catalogue standards and technological developments.

AI can be a real game-changer for libraries and other organisations needing resources. It can help streamline the acquisition process,

make buying decisions more efficient and save money. AI can be used in acquisition as stated below:

It can help with vendor selection and negotiation by analysing vendor performance, buying history and market trends. It can find the best suppliers by looking at things like price, reliability, delivery times and more. It can also help with budget planning and allocation by analysing past spending patterns and predicting future needs. AI-powered predictive analytics can help predict future resource needs by looking at usage patterns, circulation info and collection gaps, so that libraries can make smart decisions about what to get.

It can suggest new materials based on what users like, what they have borrowed in the past and what their collection development policies say. It can also help with content licensing, ensuring that libraries have the right balance of physical materials in their collections and that they are not overstocked or understocked.

AI can help with data enrichment, which means that libraries can add more metadata and content to their catalogues, making it easier for users to find the needed resources. Finally, AI can analyse costs and make cost-benefit decisions so that libraries can make purchases that make the most sense for their budget.

AI systems can be utilised to facilitate the management of subscriptions to databases, journals and other electronic resources. These systems can track usage, monitor expiration dates and suggest cost-effective changes to subscriptions that meet user needs and are cost-effective.

Additionally, AI can be used to monitor the marketplace to keep libraries informed of new and emerging sources and any changes in pricing or competitive offerings. Workflow automation can also be used to automate the acquisition process, such as the generation of purchase orders, the processing of invoices and the updating of inventory. Not only can AI applications improve efficiency, but they can also help libraries make decisions based on data that are pertinent to their collection development objectives and financial constraints. Using AI tools and analysis, libraries can improve their resource acquisition strategy and provide users with more relevant and timely materials.

AI in reference services

AI is playing a significant role in reference services. It is changing the way libraries serve users with information and support. Some of the key use cases for AI in reference services have been given below:

AI-powered virtual assistants and Chatbots are increasingly being used to help library users in real-time. These virtual assistants can answer commonly asked questions; locate resources and direct users to the appropriate library services or resources. NLP technologies allow libraries to offer more sophisticated search

capabilities and to interact with users more in a conversational way. NLP technologies can be used to create Chatbots, perform voice-activated searches and analyse the sentiment of user questions and answers. AI-driven question-answering systems, including those based on machine learning or deep learning, can answer complex user queries in more detail. Recommendation systems can use AI algorithms to analyse user preferences, search history and reading patterns to create personalised recommendations for a book, article, or other resources. This makes it easier for users to find relevant materials.

It can improve search functionality by understanding user queries and providing search results that are more contextually relevant. AI can improve precision and recall when searching for information. AI can create concise summaries of long documents or articles, so users do not have to read the whole thing. It can help create citations and bibliographies in different citation styles (such as APA and MLA).

AI can extract and format information from sources, making it easier for users to access information. AI-powered content analysis tools can help users assess online information source quality, relevance and reliability.

It can assist with multilingual support so that libraries can serve a diverse user population. AI can analyse user behaviour and interact with library systems to learn about user preferences and needs, which can be used to improve collection development, improve service and allocate resources more efficiently.

It can provide alternative formats of texts (such as audio versions) and improve user interfaces for people with disabilities.

AI-driven data analytics helps libraries monitor and analyse reference service usage patterns, user experience and performance metrics to improve services and resource utilisation.

AI can help librarians with professional development recommendations, article or publication recommendations and emerging trends in their field.

AI-driven services empower libraries to provide more efficient, personalised and easily accessible support to users. This improves the overall user experience and ensures that users have access to the information they need efficiently. However, AI-driven services must be balanced with human expertise to deliver a comprehensive, user-oriented reference experience.

AI in circulation

AI is becoming increasingly integrated into circulation services within libraries, aiming to optimise operations, enhance user experiences and optimise resource allocation. Key applications of AI in circulation include automated checkout and renewal, exemplary management, inventory management, queue management and user behaviour analysis. Further,

AI can help libraries manage holds and reservations more efficiently, prioritise requests and allocate copies of materials more efficiently. It can also help sort returned materials automatically, reducing the workload of library staff.

AI and RFID technology can be combined to make sorting and inventory tracking more efficient. It can also help predict user behaviour, like when people are likely to return materials, or when certain materials are in high demand.

It can help libraries make smarter decisions about sharing and loaning materials.

AI can help libraries better serve their customers by sending them automated notifications for things like due dates, hold availability and new acquisitions.

It can also help them make better decisions about where to allocate resources and how to manage collections. They can use AI to create mobile apps with Chatbot to help users with their circulation-related questions. But balancing automation with personalised interactions is vital to ensure AI-powered services meet their customer needs.

AI in indexing

AI can tremendously help indexing, especially when automating and making the process more efficient. It is important because it is used to organise and retrieve information from vast amounts of data, like from digital libraries and search engines, as well as from content management systems and online libraries. Some of the primary uses of AI for indexing include automated document indexing, content categorisation, entity recognition and more.

AI can help with image and multimedia indexing, auto-tagging and metadata generation to make it easier for people to find what they are looking for.

It can also help with search engine ranking by analysing user behaviour and improving search result rankings. It can also create personalised indexes for people based on their search history and

interactions with content and cross-language indexing tools can make content available to a global audience.

AI is an excellent tool for indexing, but it needs to be used with human help to ensure accuracy and relevance. For example, AI can create summaries and highlights that quickly give users a better understanding of a document, which helps them decide which one to look at next.

It can also detect and index duplicates or near duplicates, showing only the original items in the search results. Temporal indexing can also be done with AI, so users can search and get information based on specific times, like when something happened in the past or when something new came out. AI-powered indexing systems are constantly learning and adapting to the ever-changing content and needs, so they can be more efficient and accurate.

Robotics in libraries (Figure 2)

Robotics can be applied to various library functions to improve efficiency, improve user experience and streamline operations. These include:

Library security and retrieval: Robots with robotic arms can store and retrieve books and other materials. This reduces the workload of librarians and ensures that items/books are kept on the shelves/containers.

Inventory Management: Robots can constantly monitor inventory by scanning shelf locations and comparing scanned information to library databases. This helps identify missing or misplaced items and ensures that the catalogue is up-to-date.

Security: Autonomous robots equipped with cameras and sensors can patrol library spaces to monitor for security breaches or unauthorised access, providing additional security.

Document Sorting: Robots can conveniently sort documents and return documents for processing, reducing the time required for manual processing and allowing workers to focus on other tasks.



Figure 2: A talking robot from Mohd. Bin Rashid Library, Dubai.

Guidance and wayfinding: Robots equipped with displays and interactive sensors can assist patrons by providing directions, information about library services and assistance in finding the way.

Cleaning and maintenance: Robots can perform routine cleaning tasks, such as washing or maintaining floors, to keep library spaces clean and tidy.

Book delivery: In large libraries, like Hunt Library or academic institutions, robots can be used to transfer books and materials to designated locations, improving the efficiency of the delivery service.

Translation services: Translation robots can help staff and consumers communicate with people who speak different languages, improving access for different users.

Interactive programming: Robots can be programmed to interact with library visitors through interactive story sessions, educational programs, or language learning programs, making libraries more interactive for children, adults and elders.

Data collection and analysis: Bots can collect data about library usage patterns, such as foot traffic and space usage, to inform library management and improve resource allocation.

Remote library services: Telepresence robots with video conferencing capabilities can enable remote librarians to provide immediate assistance and reference services to librarians.

Retrieving books from high shelves: Robots with arms and gripping systems can retrieve books from high shelves, ensuring that users have access to all books.

It is important to note that although robotics can perform various library functions and improve operational efficiency, it should support, rather than replace, the valuable skills of people and relationships within the work framework. Libraries should carefully evaluate their institution's needs and goals when considering robotic implementations to ensure they fit in the library's goals and enhance the user experience.

ADVANTAGES OF AI IN LIBRARIES

AI offers several advantages when applied to libraries, enhancing their efficiency, user services and overall effectiveness. These are some of the key advantages of AI in libraries:

Improved search and discovery: AI-powered search algorithms and recommendation systems help users discover library materials more efficiently. These systems provide more relevant search results and suggest related resources based on user preferences and behaviour.

Automation of routine tasks: AI can automate repetitive and time-consuming library tasks, such as cataloguing, data entry and

sorting. This frees up library staff to focus on more complex and value-added activities.

Enhanced user experience: AI-driven virtual assistants and chatbots provide instant responses to user inquiries, improving user experiences by providing 24/7 support. Users can get help with queries, renewals, holds and more without staff assistance.

Personalised services: AI can personalise user experiences by recommending materials and services tailored to individual preferences, browsing history and borrowing habits. This helps users discover resources they may not have found otherwise.

Efficient resource allocation: AI analytics can help libraries optimise their collections and services by analysing usage patterns and resource demand. This informs decisions about which materials to acquire, retain, or weed from the collection.

Content enrichment: AI can analyse and enhance metadata for library materials, improving the discoverability and relevance of resources. This includes adding keywords, summaries and subject headings to records.

Accessibility: AI technologies can be used to make library resources more accessible to users with disabilities. For example, AI-driven text-to-speech and speech-to-text systems assist users with visual or hearing impairments.

Data-driven decision making: AI analytics provide valuable insights into library operations, user behaviours and collection management. Libraries can use this data to make informed decisions and allocate resources more effectively.

Enhanced preservation: AI can assist in preserving physical materials by identifying items needing conservation, monitoring environmental conditions and suggesting appropriate preservation measures.

Multilingual support: AI-driven translation and language recognition tools help libraries serve diverse communities by making resources available in multiple languages and offering language assistance.

Improved security: AI can enhance security by monitoring for security breaches, unauthorised access and fraud. It helps safeguard user data and protect digital resources.

Cost savings: While initial implementation may require an investment, AI can lead to long-term cost savings by automating tasks, reducing manual labour and optimising resource allocation.

Scalability: AI solutions can scale to accommodate growing collections and user bases, ensuring that libraries can continue to provide quality services as they expand.

Overall, AI empowers libraries to offer more efficient, accessible and user-centric services. It allows libraries to adapt to changing user needs and expectations in the digital age while maximising the use of their resources. However, it is essential to strike a

balance between AI-driven automation and the preservation of human expertise and personalised interactions in library services.

DISADVANTAGES/LIMITATIONS OF AI IN LIBRARIES

While there are numerous advantages to implementing AI in libraries, there are also potential disadvantages and challenges to consider. It is essential to be aware of these drawbacks and address them to ensure that AI applications in libraries are used effectively and responsibly. Here are some of the disadvantages/limitations of AI use in libraries:

Cost of implementation: The initial cost of developing and implementing AI systems in libraries can be high, including the costs of acquiring AI technologies, training staff and maintaining and updating the systems.

Technical complexity: AI systems can be complex and require specialised technical expertise to set up and maintain. Libraries may face challenges in finding and retaining staff with the necessary AI skills.

Data privacy and security: AI systems often require access to enormous amounts of data, raising concerns about data privacy and security. Libraries must ensure that user data is protected and used responsibly.

Biases and fairness: AI algorithms can inherit biases present in the data they are trained on. This can result in biased search results, recommendations and decision-making, which can have ethical and equity implications in libraries.

Lack of human interaction: Over-reliance on AI-driven services may reduce human interaction within libraries. Some patrons may prefer personalised assistance from librarians over automated services.

Technical glitches and downtime: Like any technology, AI systems can experience glitches and downtime, disrupting library services and frustrating users.

Lack of transparency: AI algorithms can be complex and difficult to interpret, making it challenging to understand how decisions are made. This lack of transparency can be a barrier to user trust.

Dependency on vendor solutions: Many libraries rely on third-party vendors for AI solutions. This dependency can limit libraries' control over the technology and may lead to vendor lock-in.

Skill gaps: Libraries may face challenges in recruiting and retaining staff with the necessary skills to work with AI technologies effectively.

Resistance to change: Staff and patrons may resist adopting AI technologies due to concerns about job displacement, privacy, or unfamiliarity.

Accessibility concerns: AI-driven interfaces may not be accessible to all users, particularly those with disabilities. Ensuring that AI systems are inclusive and comply with accessibility standards is essential.

Over-reliance on AI: Over-reliance on AI systems can reduce critical thinking and research skills among users who rely solely on AI-generated content and recommendations.

Ethical considerations: Libraries must navigate complex ethical issues related to AI, such as the responsible use of AI in censorship, surveillance and the handling of sensitive information.

Libraries must carefully plan and implement AI technologies while considering these disadvantages/limitations. Strategies should include thorough data governance policies, transparency in AI decision-making, ongoing training for staff and continuous monitoring to mitigate bias and improve fairness in AI systems. Additionally, libraries should engage with their communities to ensure that AI adoption aligns with user needs and values.

CONCLUSION

The use of AI in libraries offers notable advantages as well as possible disadvantages. AI technologies have several benefits for libraries. They increase operational efficiency, boost information accessibility and provide personalised services to library users. Moreover, AI can aid in organising, examining data and suggesting resources, thereby allowing librarians to concentrate on more valuable work. But, ofcourse, the necessity for meticulous execution and ethical deliberations is emphasised by apprehensions around privacy, bias and job displacement. Incorporating AI into libraries necessitates focusing on openness, accountability and user education to optimise advantages and minimise potential drawbacks. In the digital era, libraries may better serve their communities by adopting a well-rounded strategy that maximises AI's benefits while protecting against its drawbacks.

So, the article could help librarians and information professionals consider incorporating AI technology into their policies. It provides library and information professionals with new skills to enhance library services to meet user's needs and re-invent skills and competencies to drive a value-added digital transformation. It looks at things like providing information resources, organising them, storing and retrieving them and managing the circulation desk. The content could help plan for new information services and evaluate existing ones to improve the implementation of AI technology in libraries.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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