



Empowering Research Workflows and Information Retrieval in Academic Libraries through AI Tools

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Abstract

This paper investigates the transformative role of artificial intelligence in library and information science, especially in academic libraries. AI technologies are viewed as enabling components that can render the entire process of research more efficient, accelerate information-seeking, and personalize user experiences. They undertake the identification of essential AI tools for automating mundane operations, facilitating cataloging processes, and giving customized resource recommendations to catalyze service efficiency and effectiveness. Emphasizing key challenges in AI adoption-such as data privacy, algorithmic bias, resource constraints, and curricula re-training of LIS-it highlights not just the importance of transparency in AI decision-making but also advocates steps to reinforce collaboration among and continuous learning of professionals in LIS toward the successful resolution of challenges it raises. The findings call for urgent action on the way forward on the identification and appropriation of AI technologies by academic libraries in order to remain relevant and engage users in the digital era, while also addressing ethical concerns and complying with data protection laws.

Keywords: Artificial Intelligence, Chatbots, Research, Academic Library, Information Retrieval, AI Tools,

1. Introduction

Today AI has become a great leveler across many sectors more so in libraries where its integration has a great impact on the learning environments. This paper assesses the impact of

ChatGPT and AI in academic libraries, focusing on the technologies that are transforming data management, content curation, customized services and information retrieval in resourceful libraries. In the past, when seeking for materials, researchers used to rely on various subject-based classification schemes, card indexes and library catalogs which often entailed walking into the library. Even though searching for information has been made more efficient and automated in libraries through the use of the internet and library machinery, using artificial intelligence in libraries is a major shift from these traditional static and mechanistic processes to moving, interactive actions. True to their notorious tech-savvy image, libraries use AI in their quest to enhance the content structure and user-friendliness, perform dull jobs, and tailor services to the users (Cox, Pinfield, & Rutter, 2018; Gill et al., 2022; Okunlaya, Syed Abdullah, & Alias, 2022; Rubin, Chen, & Thorimbert, 2010). In line with this, because of what has been experienced before, artificial intelligence allows efficient classification more advanced searching dynamic features and capabilities that the system can offer in relation to the user such needs (Adewojo & Dunmade, 2024; Jayavadivel et al., 2024; Lu, 2024; Nardi & O'day, 1996). Similarly, to enhance user engagement and user discovery, study also harnessed user data to provide personalized resource recommendations through AI-based recommendation systems (Devika & Milton, 2024; Priya & Ramya, 2024).

In addition, as a result of collecting, storing, processing, and drawing insights from data, artificial intelligence has created an impact in the way scientific writing is done. It has been useful in brainstorming, coming up with keywords, summarizing and building bibliographies for the researchers. This shift in paradigm due to the use of AI helps explain the need for the libraries to adopt these changes in order to exist in this present age. The examples of development, such as the "library robots," indicates that AI based smart libraries are the libraries of the future, and therefore such infrastructure developments are not only possible but also inevitable (Suryawanshi, 2024).

2. Objectives

The main objectives of the study is to find out

- The role of AI in Academic Libraries.
- To identify the useful AI tools for library services.
- Analyze the impact of AI tools in research workflows.
- To discuss the challenges and limitations faced by academic libraries of practical uses of including issues related to data privacy, technical barriers, and user adaptation.

3. Scope of the Study

The article entitled "AI Tools Enhancing Research Workflows and Information Retrieval in Academic Libraries" addresses the impact of information and communications technology, particularly artificial intelligence (AI) applications, in the development of the research workflow and the information retrieval capabilities of academic libraries. It investigates several AI applications including but not limited to natural language processing (NLP) based applications, machine learning, and chatbots, and their contribution towards simplifying the research process through automation, data processing, as well as improving interaction between researchers. The article points out the advanced information retrieval transformation that is AI from sophisticated searches, recommendations systems, and upcoming modalities such as voice and visual searches. Furthermore, it elaborates on how aviators will change and adapt to the AI- based management systems by giving occurrences of the areas where issues may be experienced such as data protection and abuse of technology due to lack of capacity.

4. Literature Review

Bairagi and Lihitkar, (2024) give a detailed report on the use of Artificial Intelligence (AI) in Libraries stressing the importance of AI tools and techniques in enhancing library systems. The paper explains, in particular, the role of natural language processing (NLP) as well as large language models (LLMs) in facilitating the application of AI in the operations of the library. The application of AI tools and techniques in the operations of a library is also discussed, focusing on AI's ability to enhance the capabilities of human thinking and develop computers that can change the library space. It is expected that this evolution will address the limitations caused by physical barriers, designing intelligent library environments. The research envisions a position wherein learning experience of the readers, teachers, researchers, and students is improved greatly through the use of AI by discussing its benefits, challenges, and innovations in application in libraries.

Cox et al (2018) in their research indicate various inter alia lapses, such as whether or not the libraries will be at the trifling edge of AI machinations, ethical issues, questions about the transparency of AI decisions as well as data quality problems. There are also doubts over the employment of artificial intelligence technology in the libraries that would render the library staff redundant. Nevertheless, this document outlines a few roles that academic libraries can embrace such as developing infrastructure, adopting AI strategies, enhancing users' data literacy skills, and data sourcing and management. Devika, et al (2024) note that even though internet applications have improved access to reading and offered readers many choices, there has been an overall decline in reading cultures especially among the young generation. The research also analyzes different types of datasets contributed to book recommendation systems mentioning their characteristics, origins and objectives. Divayana et al (2015) focuses on the research of

expert systems based digital library design and implementation at Ethiopia Technology University. The research study focuses on the advantages expert system technology brings to the processes of cataloging, searching, and enabling users to access digital collections. To enhance information retrieval patterns, the digital library system incorporates the forward and backward chaining techniques in combination with a MySQL database and computer programming languages such as PHP. The research focuses on the efficiency of such systems in enhancing users' satisfaction in digital libraries as well as their success in managing academic resources in any institution of higher learning. Gill et al, (2022) investigates the concept of autonomous computing and discusses its relevance in enhancing the capabilities of future computing systems. Oluwasey et al, (2024) have explored creative informational perspectives of the libraries.

Saroja et al. (2023) made conclusions how the application of Chat GPT to library services is indeed a remarkable leap in the efficiency of research processes, user assistance and creative thinking. This AI-tuned tool offers the potential of quickening several aspects of library work such as keywords and abstracts for user-submitted texts. These attributes could enhance the engagement of scholars and students with academic content enabling effective content. Suryawanshi et al. (2024) Conducted research where several merits of integrating AI into the library processes were outlined. Some of these advantages include, little or no mistakes by the staff, having the information materials accessibility at all times, and improving the effectiveness through the mechanization of monotonous tasks. The analytics powered by AI, however, are instrumental to the libraries in predicting users' tendencies and preferences which informs the libraries on the bettering of their services in order to keep pace with their customers. Nevertheless, the article also analyses some significant barriers that the libraries in general face with regards to adoption of AI technologies. These include concerns about data protection and ethical issues, the need for trained personnel to operate certain advances in technology within the library, and the cost of acquiring and retaining AI systems.

Yousuf Ali et al., (2020) aim at determining the application of artificial intelligence (AI) in academic libraries in Pakistan about the technical and user services. The study intends to describe and demonstrate the application of AI in libraries and highlight its growing importance in the enhancement of library practices

5. Use of Artificial Intelligence (AI) Technology in Different Parts of Library Management and Services

The field of library management and services has embraced new and advanced tools and technologies, including Artificial Intelligence (AI) which focuses on enhancing not only the users' experience but also the services offered in the library. One of these tools is the Expert System (ES), software providing automated expert opinion in the area that recommends specific solutions for the provided issues. Among such expert systems in libraries knowledge base, inference engine and user interface are some of the components. The knowledge base helps

primarily in the storage and organization of the digital collections and the inference engine assists in sophisticated searches, helping in retrieving information from the collection as an expert would (Diviyana et al., 2015). The application of such systems improves the efficacy and relevance of the results obtained from the searches and therefore assists the users in sourcing the required information. In the same line, NLP or Natural Language Processing encompasses design of systems that will assist in reproducing human language with a focus improving services such as sentiment classification, summarization, translation, and chatting. Such NLP applications, allow libraries to give their users, more natural and intuitive searching interfaces.

Artificial intelligence has led to a paradigm shift in library services with the incorporation of Robotics, Recommendation Systems, and Intelligent Personal Assistant (IPA) systems. In libraries, robotics enhances productivity by carrying out material preparation, book sorting, or any other mundane tasks that require repetition. Library AI assisted chatbots helps patrons effectively by addressing any concerns patrons may have in real time or giving suggestions on areas of research and library sources. Recommendation systems are user-friendly interactive systems that employ user's preferences to different content categories, thus improving the overall content browsing and discovery experience of the user. This has made these Interactive Personal Assistants voice recognition and voice based interaction systems effective to users who have limitations of access or those who are engaged in other activities. Text Summarization and other AI applications and tools present concisely high volumes of information by drawing out their main points. Data Analytics and Big Data analysis also assist librarians in determining collection development and user engagement through evidenced based practices. Such indexing tools make use of artificial intelligence which leads to the automatic enhancement of the metadata and hence improves the availability of academic resources for research purposes. All these AI solutions combine to enable academic libraries to present their patrons smarter, quicker and individualized services, which greatly increase the productivity of both the library patrons and the library staff in their academic endeavors (Saroja, & Mazumdar, 2023).

To serve users according to their individual preferences proactively, smart services of digital libraries apply a 'human-oriented' design. This approach deploys a human-assisted, intelligent data object based on further active, sophisticated sensing technologies that permit the automatic perception of situations and basic information about users. They enable quick processing of individual data, followed by intelligent search analysis of such data to procure relevant results from available large data engines; thereafter, the data can also be streamed back to the cloud. By learning the needs of all users and proactively providing relevant information, libraries can make swift use of aggregated group data directly compare with the desires and data of each individual user. Examples of this can be helpful in guiding library users through the maze of available resources: directing them to services positioned within their learning contexts or providing recommendations of information closely aligned with their interests. These implementations enable digital libraries to enhance user experience by providing timely and customized recommendations (Yi, 2021).

Table 1 reveals the roles of libraries are in transition toward applying AI technology to deliver proactive and customized services; necessary skills to prosper in this being their core, and perhaps even other organizations that could occupy these roles.

Table 1: Library roles in AI-driven services

Library Roles in AI-driven Services	Core Competencies to be Enhanced	Alternative Providers of Service/Function
Integrating AI in Content Procurement	Procurement and licensing of e-content, licensing open access and digital content	Publisher, other intermediaries
Facilitating AI-Enhanced Content Delivery	Digitization, metadata provision & data processing.	Publisher, other intermediaries
Ensuring Data Quality and Relevance	Collection management	Data service vendors
Procuring AI Tools	Procurement and licensing of software and services	IT departments, R&D departments
Data Curation (e.g., of derived data) and Preservation	Digital preservation, management of derived data	Data repositories, archival services
Developing Data Infrastructure to Enable AI	Infrastructure design for information discovery and analysis	IT departments
Navigating the New Information Environment	Understanding scholarly publishing landscape, data creation processes	Research departments, academic consultants
Promoting Critical AI and Data Literacy	Information literacy, ethical AI use, privacy safeguards	Educational institutions, digital literacy organizations
Designing and Implementing AI Tools	Not traditionally within library roles but growing in importance	Academic departments, publishers
Data Analysis and Algorithms Developments	Not Applicable in traditional/normal library professional	IT departments, academic departments

6. AI Tools Used for Educational and Library Purposes

There is importance of AI instruments for the students, academicians and other scholars in all fields. In fact, via practitioners' claims, many academic libraries in the current century, have updated the stocks, even including, not only the purchase of e-books and journals but also the discovery and use of associated software. Libraries to Support with Technology & Software: academic librarians may argue that they have little expertise on the subject AI or that they are not allowed to discuss the topic. However, encountering AI through engaging with the tools which they maintain or support is likely.

Repository of few AI tools which can enhance librarianship services has been provided and will assist the Library staff to enhance their efficiency. And can expedite completion of tasks by the library patrons: Librarians themselves can assist and enhance the work of fellow colleagues who are researchers by applying various AI-based tools to research processes, information seeking and many other aspects of the research work. This is how the librarians can use these tools for their benefits:

- **Literature Mapping and Exploration:** Research Rabbit is good examples of such a tool where a librarian can help the researcher create a web of relationships between different papers and their authors. While tracking pertinent publications and offering suggestions, a librarian can help a researcher monitor current trends in research and ideation.
- **Generation of Language and Content:** Tools like Puzzle Labs, MEM, Fable Fiesta, and Copy.ai possess the ability to create structure and alter the content. Librarians can assist researchers in applying these devices for language processes such as modification of existing content to glossaries, producing learning resources, or fertile content creation prompted by outlines which promotes writing and learning activities.
- **Chatbot and Customized Service:** AI chatbots of Botsonic and Dante allow librarian to design and implement assistant bots that solely focus on responding to specific research questions or helping navigating through library collections. These chatbots can be adapted to use the institutional knowledge base making it possible for the users to get help instantly and accurately.
- **Rephrasing and Shortening:** Quillbot, AIHumanize and Grammarly are few important tools for a researcher who seeks to complete an objective in writing, rewording a passage or scanning for originality issues. Librarians may also instruct juniors on how to use these devices to produce polished work to enhance their academic writing skills and reputation by cutting down on cases of plagiarism.
- **Avoiding plagiarism:** Copyscape, and similar services are important for ensuring that research is original. Librarians can assist them in using such tools to ensure that their research forays are valid and properly attributed to avoid copious amounts of unwanted plagiarism.

- **Organizing Data and Controlling Docs:** Mendeley i.e., EndNote and Zotero etc., are linear and reference managers which help librarian in providing support to research scholars in organizing their references, citations and research articles effectively. With the help of these systems, librarians could facilitate researchers in enhancing their data collection process and efficacy in administering their review of the literature.
- **AI Search Engines:** Tools such as Perplexity AI and Consensus are examples of search engines with artificial intelligence that implement search functionality in a conversational turn and process research papers. Their capabilities, if adopted by librarians, can aid researchers find the required studies in an easier and faster way and help in data cross analysis and research outreach within different fields.
- **Analysis of Interactive PDF:** For instance, ChatPDF, allows librarians to assist users with research activities such as distilling information from long-winded PDFs. This enables researchers to easily access the necessary parts of books, journal articles or instruction manuals, hence reducing the time spent on the literature review section.
- **Text a Voice:** For the researchers who find it easier to talk than type, Audio Pen, an app that transcribes voice notes into formatted text is an example, turns voice notes into written text. This gadget can be suggested by the librarians because it assists in capturing the users' ideas on paper without the need of typing it out more efficiently.
- **Content organization and Archiving:** Content management platforms such as Cataloguing.AI help in the improvement in visibility of academic content by creating precise content upgraded. These tools can also be employed by librarians for better resource documentation and indexing hence easing relevant content finding by the researchers.
- **Video Content Producing:** Apart from text-based materials, tools such as Flixier enable researchers to obtain animated video presentation. In this case, librarians may assist researchers with the use of multimedia tools such as video editing, for a more effective presentation of their work.

Librarians have a crucial function to promote the productivity and efficiency of the researchers because of the availability of these artificially powered aids. They can help researchers in deploying these technologies to optimize their research processes, data handling and academic interactions, which would enhance the quality and the levels of research produced. (Bairagi & Lihitkar, 2024)

The following list of few AI tools which have the potential to transform academic librarianship for the better can use by the Library community to improve their workflow. As well as help patron to develop their research work. And can help library users to complete their tasks more quickly and accurately:

Table 2: AI tools

Name of the APP	Subject	Website
Research Rabbit	Literature Mapping	https://www.researchrabbit.ai
Puzzle Labs	Language	https://www.puzzlelabs.ai/
MEM	Language	https://get.mem.ai/
Fable Fiesta	Language	https://fablefiesta.com/
Scite	Language	https://scite.ai/assistant
Botsonic	Chatbot	https://writesonic.com/botsonic
Quillbot	Paraphrasing	https://quillbot.com/
HumanizeAI	Paraphrasing	https://www.humanizeai.io/
Grammarly	Language	https://www.grammarly.com/
Copy.ai	Language	https://www.copy.ai/
Dante	Chatbot	https://dante-ai.com/
Copyscape	Plagiarism Checker	https://www.copyscape.com/
Cohesive	Language	https://cohesive.so/
ChatPDF	Language	https://www.chatpdf.com/
Perplexity AI	Search engine	https://www.perplexity.ai/
Audio pen	Language	https://audiopen.ai/
Consensus	Search engine	https://consensus.app/
Lateral	Document Organizer	https://www.lateral.io/
EndNote	Reference Manager	https://endnote.com/
Cataloguing.Ai	Cataloguer	https://in.linkedin.com/company/cataloging-ai
Flixier	Video editor	https://flixier.com/
Zotero	Reference Manager	https://www.zotero.org/
Mendeley	Reference Manager	https://www.mendeley.com/

7. Limitations

A large number of developing countries' public and private universities often experience deficits in finances and libraries can be said to be the least sector in terms of embracing modern technologies. The funds for libraries tend to be one of the first sectors to be cut during any financial downturn or budget cuts. Most chief librarians tend to think that one of the key reasons

as to why AI related tools and technologies are hardly used is because of lack of the funds (Yousuf Ali, 2020).

The other issue that librarians identify with regard to the barriers to the application of AI in libraries is technological insufficiency. The use of AI-based solutions is unsuccessful due to the presence of obsolete computers, low-speed internet, and the absence of essential application software. This is the technological factor that explains the slow gradual rate of acceptance of AI technologies in libraries (Wheatley and Hervieux, 2019).

In order to enhance the employability of the future librarians, there is the burning necessity of reviewing the content of the Library and Information Science (LIS) syllabi. LIS instructors also need to acquire information technology in order to be able to make changes in the content of their teaching. Nevertheless, advancement of knowledge in this direction is seriously compromised by the available resources and support. One of the greatest difficulties faced by LIS researchers and teachers is the rapid development of technology. Researchers and educators have to upgrade their competences and skills to be able to successfully integrate new resources, platforms and techniques in their research and teaching. This includes understanding the role of technologies in the management and dissemination of information, such as blockchain, artificial intelligence, and machine learning (Bairagi and Lihitkar, 2024).

Integration of AI in libraries is complicated by ethical issues. Important issues are data privacy, bias in algorithms, and the clarity of AI's decision-making processes. It is important to note that libraries deal with information that is sensitive in nature which calls for adherence to the laws protecting personal data whenever artificial intelligence is being introduced. Algorithmic Indifference is an important issue, as AI risks systems exhibiting 'behaviour' where they are exposed to prejudiced data, to reinforce inequality and prejudice. Since these are the core services provided in libraries and in order not to break public trust, it is important to manage the ethical considerations in decision making development in advanced systems such as AI (Hodonu-Wusu, 2024; Rajkumar et al., 2024).

In order to further this area of study however, many obstacles general LIS professionals will have to face. They may, however, encourage the progress of library and information science if such challenges are dealt with through teamwork, creativity, and continuous improvement.

8. Conclusions

Bringing artificial intelligence (AI) into library and information science (LIS) may lead to the revolution of the field. AI tools like chatbots, machine learning, and natural language processing are becoming more common in many libraries. Providing better search results, faster scientific workflows, and a more personalized experience for users, are some of the ways AI technologies

are changing the landscape of academic library services. By the time of their adoption in libraries, however, many AI technologies were already drawing criticism, particularly in regard to being black-boxed and opaque. Libraries also need to seriously consider problems in algorithmic bias, data privacy, and ethically-sound AI.

By working together, LIS professionals must break beyond those barriers while also responding to lifelong learning. Libraries can create a culture of sharing knowledge and expertise so they can become adaptive and flexible to the rapid advancement of AI technologies. The paper posits that one of the most significant things in upgrading LIS curriculum is to prepare future library employees for effective use of the new technologies through AI training.

Above all, libraries can plan to use AI carefully to remain highly relevant in the digital age, improving organizational efficiency and enhancing user engagement. But as the future of AI integration begins to model the emergence of deeply relevant library services, ongoing inquiry and an adherence to ethical norms will be needed to guarantee responsible, inclusive use of these technologies in shaping the future of library services.

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