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# Artificial intelligence implementation strategies for Ghanaian academic libraries: A scoping review

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ABSTRACT

The purpose of this scoping review is to assess the scope of available literature on artificial intelligence (AI) application in libraries with a view to providing strategies for the implementation of AI in Ghanaian academic libraries from relevant literature. The study adopted the framework outlined by Arksey and O'Malley (2005) to enable the retrieval of documents from a major citation database SCOPUS. Relevant articles searched and retrieved were based on Abstract, and Title search on artificial intelligence and academic libraries which comprised the two broad concepts of the study. Data collection was carried out in two phases: phase one from October 2022 and phase two in November 2023. Out of a total of 542 documents retrieved based on a search strategy, 518 met our inclusion criteria. Title, abstract and full text screening of the documents resulted in a total of 478 relevant articles for case analysis. The study outcome after an analysis of the articles deemed relevant and considered for inclusion in the study (478) resulted in the establishment of five major themes: namely" study categories, continental adoption rate, study objectives, study findings and study recommendations which were captured from various cases of articles analyzed.

## Background

The application of computers and machines to man different aspects of organizational processes became prevalent in the 1950's. The adoption of Information and Communication Technologies (ICTs) has transformed academic library operations and services, and has enabled libraries to leverage various tools, including computers, databases, Online Public Access Catalogue (OPAC), internet connectivity, social media, and multimedia resources to improve their services (Ogwo, Ibegbulem, & Nwachukwu, 2023). However, it was not until the 1990's that this equipment was used in libraries to provide knowledge-based services to library patrons (Asemi, Ko, & Nowkarizi, 2021). Historically, academic libraries have existed to provide diverse resources and services to support teaching, learning and research. The rapidly evolving technological landscape across various spheres of human endeavours has significantly influenced the operations of academic libraries around the globe. Academic libraries are leveraging the opportunities of the Fourth and Fifth Industrial Revolutions by adopting technology in their operations and services, as they have always been at the forefront of adopting new technologies to improve their services.

Indeed, as service-oriented organizations, changing roles of libraries and especially academic libraries has compelled academic libraries to embrace emerging information technologies to provide digital technology-driven services in the digital age (Hussain, 2023). Key among the emerging technologies being adopted by academic libraries globally is artificial intelligence (AI). Today, the concept of artificial intelligence (AI) is an almost global household phenomenon and has been deemed to result in innovative transformations and new competitive advantage (Jha, 2023). In fact, over the last two decades however, no technological advancement has been as dominant than that of artificial intelligence (Hervieux & Wheatley, 2021) and now more than ever, libraries in developing countries need to progress from automation and digitization to the adoption of AI to minimize the interference of human interaction.

According to Choukimath et al. (2019, p.1), artificial intelligence is "the collection of technologies that enables machines to sense, comprehend, act, and perform several functions matching up with human intelligence". Generally, artificial intelligence has been

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0099-1333/© 2024 Elsevier Inc. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

described as the science and engineering of making intelligent smart machines and devices, that are able to learn new concepts and tasks, reason and draw useful conclusions about the world around, understand a natural language, comprehend a visual scene and perform other types of feats that ordinarily require human types of intelligence (Chemulwo & Sirorei, 2020; Omame & Alex-Nmecha, 2020; Wang, 2019). Artificial intelligence (AI) in libraries refers to the integration of advanced technologies that enable libraries to enhance their services, improve operational efficiency, and provide better user experiences (Ali, Naeem, & Bhatti, 2020; Hussain & Ahmad, 2024). Likewise, the application of artificial intelligence in libraries has been acknowledged as a collection of innovations that offers libraries access to technologies that can sense, comprehend, act, and learn (Oyetola, Oladokun, Maxwell, & Akor, 2023). Nevertheless, to update and expand their services as well as promote their relevance in the modern digital world, academic libraries must comprehend the opportunities, advantages and risks associated with AI (Harisanty, Anna, Putri, Firdaus, & Noor Azizi, 2023; Hussain, 2023; Pival, 2023).

Like all other libraries, the ever-increasing volumes of information (big data) have called for its quick processing and generation of reliable results in acceptable formats to meet the diverse needs of patrons of academic libraries. In responding to these needs some academic libraries, especially in the developed world have started applying AI tools to enhance the effectiveness of library services (Subaveerapandiyan, Sunanthini, & Amees, 2023). Hence, currently artificial intelligence is gaining significant attention in academic libraries around the globe. In academic libraries, there are several AI tools which include natural language processing such as Google Assistant and Voice Searching; Chatbots like IBM Watson, Sri, and Alexa; text data mining; pattern recognition; big data technologies, machine learning, robotics, and expert systems (Ali et al., 2020; Echedom & Okuonghae, 2021; Ogwo et al., 2023). AI tools like Google Assistant, Voice Searching, Google Translate ChatGPT, and Text Data Mining are free and they are effective for basic functionalities, while subscription-based tools offer more advanced features and support (Ali et al., 2020). These tools can be applied to artificial intelligence applications such as technical services, descriptive cataloguing, subject indexing, and collection management; subject analysis and representation, reference library services, searching databases, and document delivery (Okpokwasili, 2019). The applications of these systems help to carry out the various tasks for the library such as budget, people, collection development, and scheduling to improve user services such as reference provision, information storage, and retrieval (Vijayakumar & Sheshadri, 2019).

The prospects of AI in academic library services are unprecedented as these provide opportunities to enhance library operations owning to its capability for learning, reasoning, and problem-solving. As such, Jha (2023) emphasizes the need for academic libraries and librarians to understand the opportunities, benefits, and risks of Artificial Intelligence technology. The impact of artificial intelligence on academic libraries has yielded positive outcomes, leading to enhancements in information search and retrieval methods, discovery searches, chatbot interactions, and data mining (Choukimath et al., 2019). Similarly, Ali et al. (2020) indicated that the integration of artificial intelligence in academic libraries is essential for enhancing service delivery, enhancing operational efficiency, and meeting the dynamic needs of users in an increasingly digital and data-driven environment. Likewise, Mallikarjuna (2024) acknowledged that AI can enhance academic library services and operations by offering tailored recommendations, computerizing metadata creation, and facilitating data-driven decision-making. Certainly, the application of AI in academic libraries will provide users with reliable information, and facilitate a natural integration between readers and libraries (Hussain, 2023).

That said, though many developing countries appreciate the need for AI, they are yet to apply AI technologies to expand the capacity of library services and workflows (Adetayo, 2023). Indeed, in Nigeria Adejo and Misau's (2021) study found that to meet the current global trends in librarianship, librarians have started integrating artificial intelligence into the library system to meet the current trends in the country. Still in Nigeria, Yusuf, Adebayo, Bello, and Kayode (2022) also stressed that AI technologies can facilitate the discovery of library materials by users through the implementation of intelligent tutoring systems and automated library services, and enhance information processing and search capabilities, leading to a more efficient experience for staff and patrons (Yusuf et al., 2022). Wheatley and Hervieux (2020) indicates that majority of academic libraries are less responsive to current AI trend and only few are open to AI implementation in their libraries due to some obvious challenges. Hussain and Ahmad (2024) indicated that it poses several challenges such as the necessity for reliable data to train AI algorithms and the risk of bias in AI systems.

Nevertheless, though AI has proven to be useful, some issues regarding its usage have been raised including the lack of privacy, bias, high cost, ethical issues, and the impact on employment and social equality (Adetayo, 2023; Cox, Pinfield, & Rutter, 2018; Hussain, 2023). In the same vein, despite the numerous opportunities AI presents to the library fraternity, its adoption rate is very low, particularly in the developing countries. Hussain (2023) observed that academic libraries, especially those from underdeveloped nations, still show some level of ignorance of the use of AI due to factors such as lack of knowledge on the use of AI, high cost of integrating AI into library services and lack of research linking AI to librarianship. Adetayo (2023) equally puts forward that the demerits associated with the use of AI such as unemployment, misuse of information, inaccurate query response and poor comprehension may pose some risk in their usage despite its advantages. Nevertheless, the risk associated with the use of AI aside, Enakrire and Oladokun (2023) indicated that the great potential for libraries to disseminate and transfer information and knowledge remains undisputed, and hence regardless of their geographical context, AI would continue to serve as a panacea to future library services. This paper hence examines publications on AI application tools following a scoping review of the literature with a view to providing strategies for the implementation of AI in Ghanaian academic libraries from relevant literature. The rest of the paper is structured as follows: an overview of academic libraries in Ghana, Methods and procedures, Findings and Results, Discussion of findings, Conclusion, and Recommendations for Ghanaian academic libraries.

## Overview of Ghanaian academic libraries

According to Ghana Tertiary Education (GTEC), (assessed 20 July 2022) Ghana has forty-one accredited (41) universities ranging from public universities (15); private universities (7); professional institutions according to public university status (9) and public technical universities (10) offering various degree programmes. All the universities have libraries which are mandated to support teaching, learning and research of the university. In fulfilling this mandate, libraries provide a wide range of scholarly materials to support the curricula and research needs of the institution. They also provide a variety of services to facilitate access to information both print and non-print materials. Services range from circulation and reference services, online reservation of books, recommendation of library materials, current awareness service, inter-library loan service, photocopying/printing service, orientation and information sessions, selective dissemination of information, and audio among others. Many of these services were traditionally performed, however, with the application of technology, these services have been automated. The common areas of library automation in many university libraries in Ghana are in the areas of acquisition of materials, cataloguing and indexing, circulation control and serials control, library administration and management, online public access catalogue, information retrieval and dissemination, databases searches, inter-library loans, access to e-resources through the internet, institutional repositories, and desktop publishing (Sindhav & Patel, 2014). Library automation is facilitated by computer technology, telecommunication,

and reprographic technologies. The selection of suitable library management software enabled the automation of these areas in libraries. However, no author has been cited to have written about the application of AI in Ghanaian university libraries.

## Methods and procedures

A scoping review was carried out to identify relevant literature on artificial intelligence use in academic libraries from the SCOPUS citation databases. The scoping review was done in two phases. The first phase was in October 2022, and the second phase was in November 2023. Hence the articles reviewed included papers which have been published on AI in academic libraries up-till November 2023 from across the globe. A scoping review was chosen because, the data relative to the traditional academic literature on artificial intelligence use in libraries especially in Ghana is less well-known (Higgins & Green, 2011). Again, SCOPUS was chosen due to its merit as one of the largest databases worldwide. The scoping review was performed in accordance with the five-stage methodological framework outlined by Arksey and O'Malley (2005). The stages include: (1) identifying the research questions, (2) identifying the academic and grey literature, (3) selecting the literature, (4) extracting and charting the data, and (5) collating, summarizing, and reporting the results.

### *Stage1: identifying the research questions*

The research questions are intended to serve as a guide to search and synthesize all the literature pertinent to the study, with the goal of achieving the study purpose. Three (3) research questions guided the study:

1. What relevant literature has existed to date on the application of AI in academic libraries?
2. Which AI techniques are applied in academic libraries?
3. What strategies can be adopted for the implementation of AI in Ghanaian academic libraries?

### *Stage 2: identifying academic and grey literature*

After the research questions were formulated, the researchers proceeded to the second stage which was to identify relevant studies. First, a search strategy was developed. To achieve this, search terms were derived and used to identify relevant studies comprising synonyms of artificial intelligence and academic libraries as the main key concepts. Date limitations were not set, and hence, the searches covered the time-period from the inception of literature existing on artificial intelligence in academic libraries to November 2023. Literature searched at this level was from March 1977 to November 2023. A search strategy was developed using search strings. The search strategy combined keywords, and text terms of the synonyms of the two key concepts and was carried out with the help of three librarians who are included as authors in the study. To aid analysis, only English language studies were included. These documents were further limited to journal articles, which discussed the application of AI in different aspects of library activities. The full search strategy is presented in Table 1.

**Table 1**
Search strategy.

| Search line | Search query | Search String | Results |
|---|---|---|---|
| 1 | Keywords 1/0R | TITLE-ABS (“artificial intelligence” OR “expert systems” OR “machine learning” OR robotics) | 819,959 |
| 2 | Keywords 2/OR | TITLE-ABS (“intelligent retrieval” OR “knowledge engineering” OR “natural language processing” OR “pattern recognition”) | 133,509 |
| 3 | 1 OR 2 | (TITLE-ABS (“artificial intelligence” OR “expert systems” OR “machine learning” OR robotics) OR (TITLE-ABS (“intelligent retrieval” OR “knowledge engineering” OR “natural language processing” OR “pattern recognition”)) | 931,180 |
| 4. | Keywords 4/OR | TITLE-ABS (“academic librar*” OR “university librar*” OR “learning centres” OR “learning centers “OR “information centres” OR “information centers” OR librarian* OR “library staff*” OR “information worker*”) | 591,172 |
| 5. | 3 AND 4 | (TITLE-ABS (“artificial intelligence” OR “expert systems” OR “machine learning” OR robotics) OR (TITLE-ABS (“intelligent retrieval” OR “knowledge engineering” OR “natural language processing” OR “pattern recognition”) AND (TITLE-ABS (“academic librar*” OR “university librar*” OR “learning centres” OR “learning centers “OR “information centres” OR “information centers” OR librarian* OR “library staff*” OR “information worker*”) | 542 |
| ***6.*** | Limit to English Language | (TITLE-ABS (“artificial intelligence” OR “expert systems” OR “machine learning” OR robotics) OR (TITLE-ABS (“intelligent retrieval” OR “knowledge engineering” OR “natural language processing” OR “pattern recognition”) AND (TITLE-ABS (“academic librar*” OR “university librar*” OR “learning centres” OR “learning centers “OR “information centres” OR “information centers” OR librarian* OR “library staff*” OR “information worker*”) AND (LIMIT-TO (LANGUAGE, “English”) | 518 |

Source: SCOPUS search results Nov. 2023.

### *Stage 3: selecting the literature*

Three procedures were employed at this stage. These were the title screening, abstract screening, and full text screening. At the first level full titles of items retrieved from the literature search were carefully checked to exclude those titles that were deemed not to be suitable for the study. Thereafter, at the second level, all corresponding abstracts of items that were deemed relevant and included in the title screening phase were thoroughly assessed to identify potentially relevant items. Afterward, at the third level, a full text screening of potential items was done, and consensus was reached for agreements and disagreements between all the researchers regarding articles that were deemed germane to the study's mandate. The inclusion of an article was based on the verification that the document was indeed centered on artificial intelligence in academic libraries.

### *Stage 4: extracting and charting the data*

In the fourth stage, a rigorous data extraction of the items which passed the full text screening stage was conducted. Metadata were extracted from each article include the: author/authors, publication year, study setting, study purpose, methodology, study findings, recommendations, conclusions, limitations, and areas for further studies.

### *Stage 5: collating, summarizing, and reporting the results*

At the fifth stage, a search collation and summary flow chat (see Fig. 1) were developed based on data extracted from items that met the initial search criteria from stages 1 to 4 as discussed above. As shown in Fig. 1, five hundred and fourth two (542) papers met the inclusion criteria after the identification stage. At the level of title screening, 507 items were selected from the 518 papers that were in English. Afterwards, the abstract screening gave a total of 481 items which were

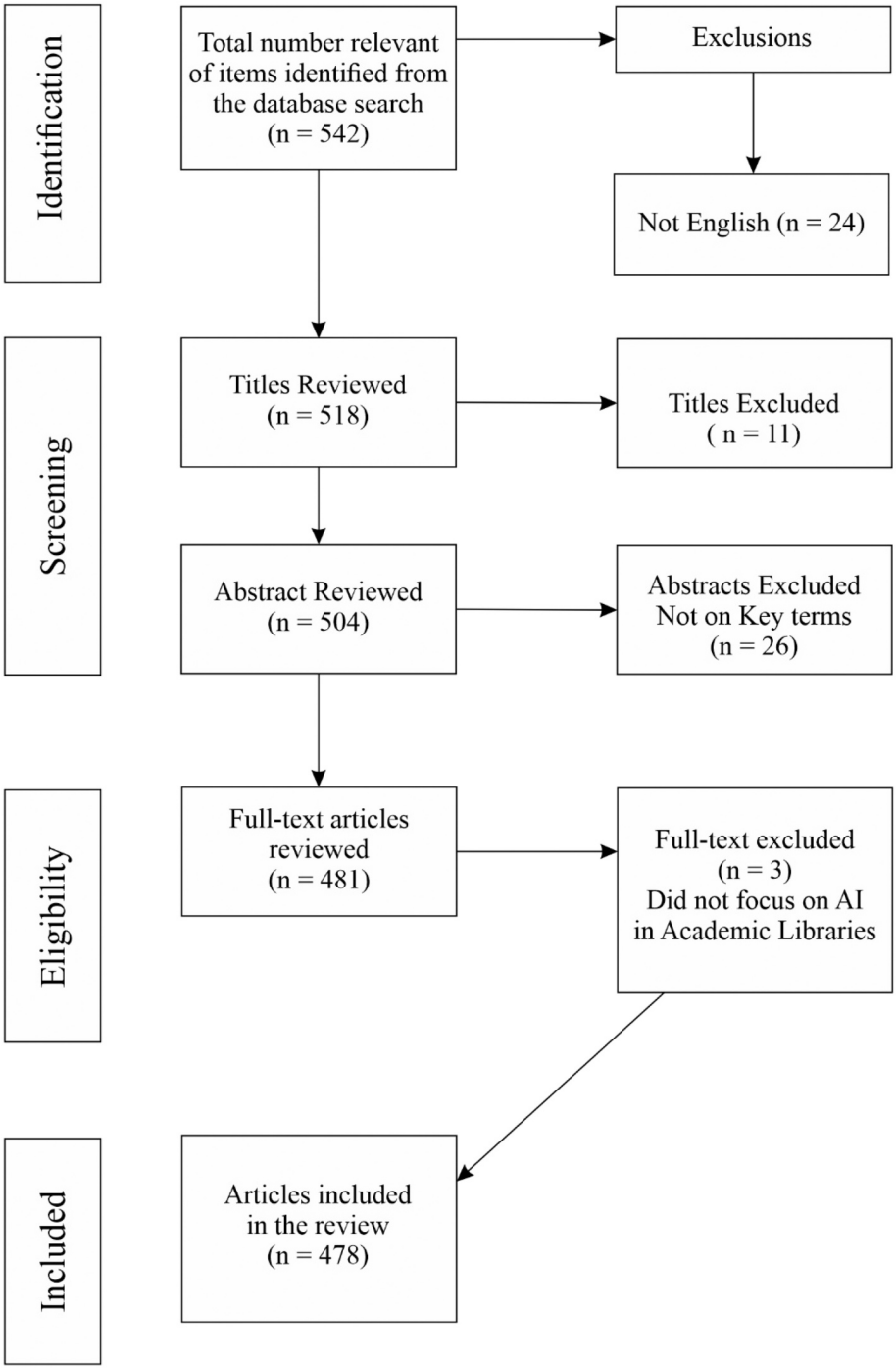


**Fig. 1.** Search collation and summary flowchart.
Source: Scopus Database 1977–Nov. 2023.

further considered for full text screening. Four hundred and seventy-eight (478) articles passed the full text screening and hence were eligible to be used for the review as depicted in Fig. 1. Subsequently, the 478 articles that were eligible for the study were carefully analyzed by the researchers to come up with key concepts that will aid the write up of the study findings and or results. Key extractions from each eligible article included: author/authors, publication year, study setting, study purpose, methods and procedures, study findings, recommendations, limitations, areas for further studies, and conclusions.

After the key extractions, five themes were carefully outlined by the researchers to form the study outcome or results as presented in Fig. 2. The themes included: study categories, continent adoption rates, study objectives, study findings, and recommendations.

To start with, as shown in Fig. 2, different studies have been conducted using various methodologies and procedures to investigate the adoption and use of AI in academic libraries. Findings from the literature shows study categories ranging from qualitative and quantitative studies (e.g. Clark & Lischer-Katz, 2023; Dube & Jacobs, 2023; Lund et al., 2020; Yoon et al., 2022), systematic reviews (e.g. Harisanty et al., 2023), taxonomy studies (e.g. Asemi & Asemi, 2018), literature reviews (e.g. Echedom & Okuonghae, 2021) and scientometric analysis (e.g. Borgohain, Bhardwaj, & Verma, 2022). These studies generally agree on the potential of AI as a significant tool to change the traditional library services and processes, leading to favorable changes in the work of the

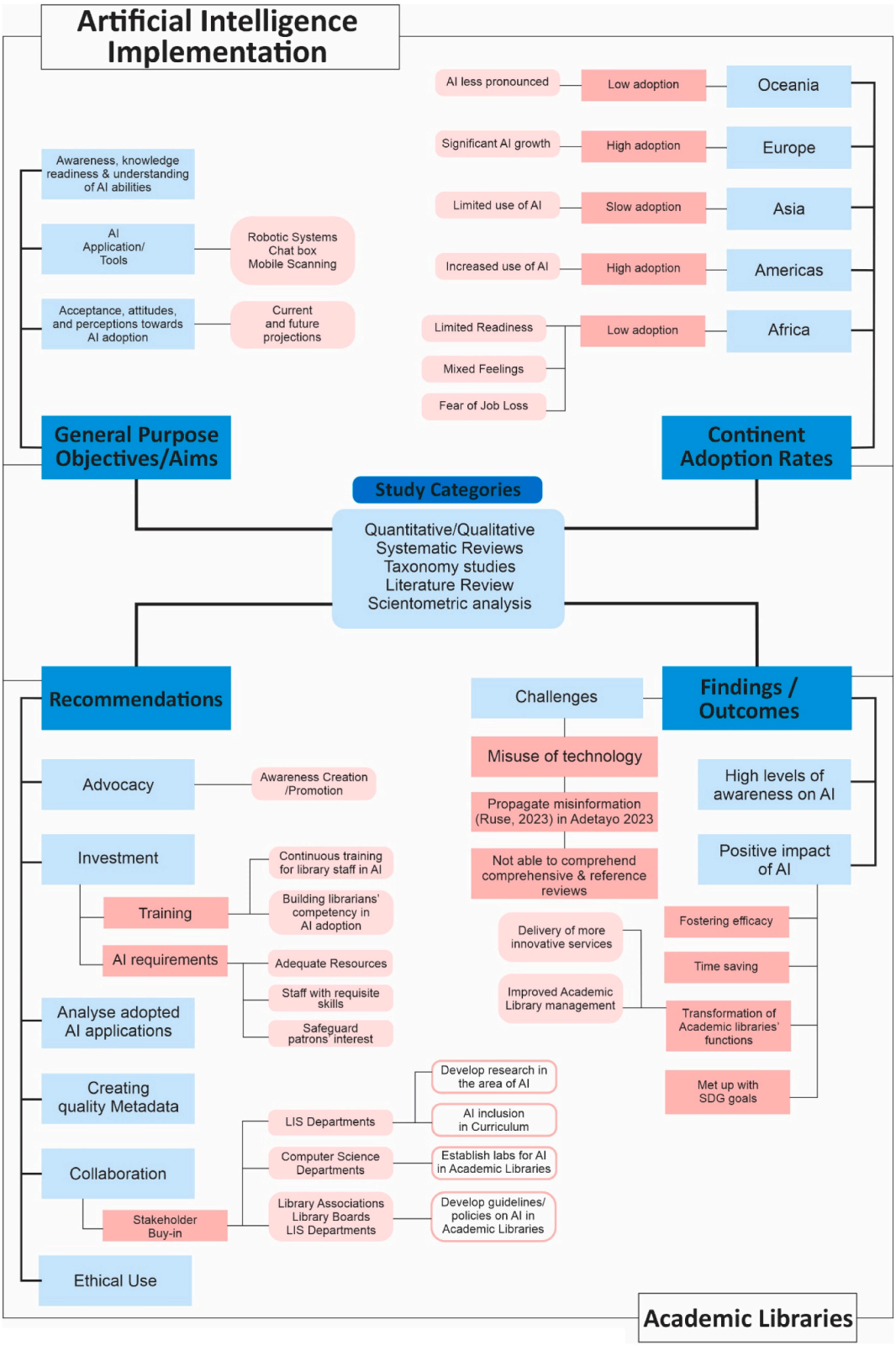


**Fig. 2.** Study outcome on AI implementation in academic libraries.

library. Indeed, as recently published by Harisanty et al. (2023), AI can be implemented in several areas of the library such as cataloguing, referencing and information service, information literacy, and reader communication among others.

With regards to continental adoption rates, the literature reveals a high adoption rate with significant growth and use of AI in academic libraries in Europe and the Americas (e.g. Jha, 2023; Smith, 2022). Conversely, studies conducted in academic libraries in Asia (e.g. Asim, Arif, Rafiq, & Ahmad, 2023) revealed slow adoption rates, with a limited use of AI among the academic libraries. Likewise, studies from Oceana

(e.g. Al-Aamri & Osman, 2022; Tait & Pierson, 2022) also revealed a low level of adoption of AI, where the use of such technologies was recorded as less pronounced. Similar to Oceana, studies from Africa revealed that due to factors such as fear of job loss and mixed feelings towards the adoption of AI, academic libraries on the continent seem not to be ready for the adoption of such technologies resulting in a low adoption rate of AI in academic libraries for service provision (Igwe & Sulyman, 2022; Owolabi, Fauziyah, Adeleke, Taiwo, & Adesina, 2021; Oyetola et al., 2023).

Furthermore, the literature indicates that the adoption of AI by academic libraries is well documented in the literature and shows three main segments relative to the purpose and or aims of these studies. The first group of studies includes studies conducted on the awareness, readiness and understanding of the abilities of AI in academic libraries (e.g. Abayomi, Adenekan, Abayomi, Ajayi, & Aderonke, 2021; Ajani, Tella, Salawu, & Abdullahi, 2022; Frederick, 2023; Owolabi et al., 2021). The second segment of studies comprises research focusing on the different AI tools that could be deployed or are being deployed or could be adopted and used by academic libraries for library services provision (e.g. Safadel, Hwang, & Perrin, 2023; Sanji, Behzadi, & Gomroki, 2022). Studies in the third segment (e.g. Kaushal & Yadav, 2022; Lin, Chiu, & Lam, 2022; Lund, Omame, Tijani, & Agbaji, 2020; Subaveerapandiyan et al., 2023) were however, directed at the acceptance, attitudes, and perceptions of librarians towards the acceptance of AI, difficulties in implementing such platforms and ways to mitigate such challenges, as well as the current and future projections of AI in academic libraries (e.g. Echedom & Okuonghae, 2021; Oyelude, 2021).

Additionally, articles included in the scoping review came up with various findings that affirm the importance and need for AI application in library services provision. Indeed, studies show a high level of knowledge and awareness among academic libraries on AI (Wildgaard, Vils, & Johnsen, 2023), and reveal a positive impact of AI on the activities of the libraries (e.g. Jha, 2023; Safadel et al., 2023; Sanji et al., 2022; Subaveerapandiyan et al., 2023). Popular among the benefits of AI were its ability to foster efficiency, saving the time of the user, and the transformation of academic library activities such as the delivery of more innovative services and improvement in academic library management processes. These studies again revealed the use of robotics, chat box and mobile scanning as the main AI tools deployed in academic libraries (e.g. Safadel et al., 2023; Sanji et al., 2022).

Further, given that several of the study findings were confident about the opportunities AI will present to academic libraries, there were concerns about the adoption of AI, and some hurdles such as job security, technological difficulties, misuse, inaccurate query response and poor comprehension (Abdulwahid et al., 2023; Adetayo, 2023; Frederick, 2023; Kaushal & Yadav, 2022). Adetayo (2023) for instance signaled academic libraries to carefully assess the risk involved in using AI tools such as ChatGPT and take initiatives to limit the unacceptable usage of such technologies, since the risk involved in using AI can be extremely high despite its advantages. Hence, libraries need to understand, use, and become savvy about both pros and cons of AI (Frederick, 2023).

Moreover, the studies reviewed again provided some recommendations to academic libraries that could help in the quest to deploy AI tools into their service provision to users. These included advocacy towards awareness creation and promotion of AI as a measure to delineate various challenges associated with AI in library operations (Hussain, 2023; Ridley, 2022) and investment in AI by academic libraries through the provision of adequate resources as well as continuous training programmes for library staff in AI to build the competency levels of librarians on the use of such tools for library service provision (e.g. Al-Aamri & Osman, 2022; Ali, Naeem, Bhatti, & Richardson, 2022; Echedom & Okuonghae, 2021). Some studies also recommended academic libraries to analyse and adopt AI tools that will best suit their interests (e.g. Duncan, 2022; Gasparini & Kautonen, 2022; Ridley, 2022; Smith, 2022) as well as the creation of quality metadata (Corrado, 2021). The need for collaboration was very loud in the recommendations proposed by the studies on AI in academic libraries. The first was the request for Library and Information Science (LIS) Departments across the globe to develop research in the area of AI, and where possible include AI in the LIS curriculum (Tait & Pierson, 2022; Yoon, Andrews, & Ward, 2022). In another breadth, there were proposals for academic libraries to collaborate with Computer Science Departments within their environs to establish laboratories for AI in academic libraries (e.g. Ali et al., 2022). There were also calls for library associations such as international library associations (IFLA), continental library associations, and national library associations to develop guidelines and policies on AI applications in academic libraries to ensure some level of standardization in the academic libraries' AI journey (Clark & Lischer-Katz, 2023; Harisanty et al., 2023; Ridley, 2022; Yoon et al., 2022).

## Proposed strategy for the implementation of AI in Ghanaian academic libraries

A key objective of this scoping review was to recommend a strategy for academic libraries in Ghana towards the effective implementation of AI. Based on the findings from various studies on AI in academic libraries, the researchers delineated some recommendations which are anticipated to strengthen and aid academic libraries especially in Ghana in their AI journey. The recommendations are therefore intended to assist academic libraries in Ghana to close gaps in terms of AI adoption for the provision of, and access to library services and offers various worthwhile implications in terms of strategies for academic libraries to increase their AI adoption rates. Key strategies for the implementation of AI in academic libraries in Ghana include, the development of an AI policy and plan, training and education of library staff and patrons on AI applications, creation of applications specifically for library use, ethical use of AI, guidelines on the use of AI, and the inclusion of IA in the library and information science curriculum.

First, in ensuring successful stories in the application of AI, academic libraries in Ghana should develop a plan as part of their AI adoption and implementation strategy to provide direction. This requires a careful analysis of the available AI tools to choose the ones that best fit the interest and purpose of the library's vision and mission. Furthermore, awareness creation and promotion of AI application tools, with the aim of outlining and making known the benefits of using such tools in the academic libraries' activities to both staff and patrons of the library forms an essential part of revealing the need for AI in academic libraries. Academic libraries in Ghana can explore the potential of popular AI applications such as chatbots, ChatGPT, Google Bard, and Bing among others, particularly those that are free or open access, to enhance their services and operations. By leveraging these cost-effective solutions, academic libraries in Ghana can improve efficiency, innovate services, and better support the academic community. Some examples of free or open access AI applications that academic libraries in Ghana could consider include Free AI-powered tools for tasks like citation management (e.g., Zotero) or language translation (e.g., Google Translate), Open access AI-driven resources for research and learning, such as the OpenAI Gym, and an open-source machine learning library for building and training AI models such as PyTorch among others. Academic libraries in Ghana should hence involve and orient both their staff and patrons on the need to accept AI. Indeed, involving patrons and staff right from the beginning could increase interest in the adoption and use of such tools. Again, there is a need for a mechanism for feedback from users on the use of such tools. This will help academic libraries to find out if their AI adoption intentions have been achieved or not and if not come up with alternative strategies.

Further, as depicted in the literature, especially in today's information explosion era, AI in library services will provide users with access to reliable information and serve as a useful tool for the natural integration of readers and libraries (e.g. Hussain, 2023). Since the use of AI in library services will benefit both staff and patrons, there is a need for

academic libraries in Ghana to have appropriate training programmes as well as hands-on training on the application of AI tools in library activities. This training should be as frequent as possible and should form an essential part of the academic libraries' activities towards enhancing AI adoption. To enhance AI capabilities, academic libraries in Ghana can participate in webinars, conferences workshops and training sessions, potentially in partnership with professional organizations like the Ghana Library Association and library and information schools. This collaborative approach can facilitate the formation of specialized library AI teams within academic libraries. The ultimate goal is to equip Ghanaian academic libraries with a dedicated team of staff possessing expertise in AI applications. As emphasized by Cox (2023), librarians must develop their skills in educating users about AI's role in library services, its impact on information search and discovery, and its implications for the future of librarianship.

Furthermore, Ghanaian academic libraries can empower their staff by developing skills in AI tool development, enabling them to create customized, self-owned AI applications tailored to their specific needs. By doing so, academic libraries in Ghana will transition from being mere users of external platforms to becoming developers and owners of their own AI tools. This approach will grant academic libraries in Ghana the autonomy, confidence, and control over their AI solutions, ensuring they have the expertise, security, and authority to shape their own technological future.

Prior to adopting AI technologies, academic libraries in Ghana should establish a comprehensive plan for their ethical utilization. This can be achieved by developing an AI ethics policy, created in collaboration with the consortium of academic and research libraries in Ghana, to serve as a guiding framework for AI tool implementation. By proactively addressing ethical concerns through this policy, libraries can minimize the risks of AI misuse and misinformation, ensuring responsible and beneficial adoption of these technologies.

Additionally, establishing guidelines for the utilization of AI tools in Ghanaian academic libraries is crucial. The Ghana Library Association can play a pivotal role in facilitating the development of these guidelines, which can provide a framework for the adoption and implementation of AI applications in library services. These guidelines should encompass standards, ethical considerations, and best practices for AI implementation, serving as a foundation for individual libraries to develop their own AI policies and ensure responsible adoption of these technologies.

Further, academic libraries in Ghana, through the Consortium of University Libraries in Ghana, could leverage the Library and Information Science school at the University of Ghana, namely the Department of Information Studies, to include AI in their curriculum. By partnering with this department, academic libraries in Ghana, can ensure that diploma, undergraduate, and graduate (Master's and Ph.D.) programmes integrate AI into their curriculum, particularly at the master's level. This strategic collaboration will empower future librarians with the necessary AI skills and competencies in AI application in academic library activities. Indeed, as the adage goes "Charity begins at home". Moreover, academic libraries in Ghana can expand their partnerships to include Computer Science Departments in their various Universities and other stakeholders, providing library staff with comprehensive training on AI-related technologies and applications.

## Conclusions and practical implications of the study

This study has been able to establish what is reported in the literature so far on the implementation of AI in academic libraries globally. The findings from the literature provide a clear picture of the issues related to the application of AI in academic libraries for the provision of library services and resources. The findings of this study are intended to help library directors and administrators in Ghana to be knowledgeable about the different AI tools which they could implement in their libraries to enhance service delivery to patrons. The study also provides useful references and practical contributions for developing countries which have not yet contemplated the implementation of AI in their academic libraries and may serve as a guide for future researchers in their understanding of AI applications among academic libraries. Further, the current study can be implemented as a strategy for the effective and efficient deployment of AI to encourage the adoption and use of the various AI tools especially in academic libraries in developing countries such as Ghana. Academic libraries generally could leverage on the findings of this study and proposed recommendations to make informed decisions and come up with guidelines towards the implantation of AI in the provision and access to library services and resources while improving patrons' acceptance and use of such tools.

## Recommendations for further research

Despite the practical contributions of the study, it is important to acknowledge the study's limitations, which can be considered for future studies. First, as previously reported, the current study used articles exclusively from the SCOPUS database. Given that there are quite a number of databases from which articles could have been accessed and used to study AI in academic libraries, it would be interesting to extend this study to a wider scope or to carry out a 'cross-database' comparative study to overcome this limitation.

## CRediT authorship contribution statement

**Monica Mensah Danquah:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Perpetua Sekyiwa Dadzie:** Writing – review & editing, Writing – original draft, Supervision. **Kwesi Gyesi:** Writing – review & editing, Data curation. **Francis Yeboah:** Writing – review & editing, Data curation. **Christian Yirenkyi Nyarko:** Visualization, Methodology, Data curation.

## Declaration of competing interest

We (authors) declare that this is an original manuscript based on a study conducted by the authors mentioned therein in the manuscript and that this manuscript does not contain any artificial intelligence generated content, nor sent out to another journal for publication consideration. This study was not funded nor received any funding.

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