Artificial Intelligence in Library and Information Science:
A Systematic Review of Applications and Challenges

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Abstract: This study aims to systematically review studies on the application of Artificial Intelligence (AI) technologies in the Library and Information Science (LIS) area. It focuses on AI associations with key LIS areas, challenges, and offers a critical insight into how AI is transforming the LIS areas. A systematic review of peer-reviewed papers (2000-2024) was conducted using the Web of Science (WoS), Library, Information Science & Technology Abstracts (LISTA), and Library Literature & Information Science (LLIS). Following PRISMA guidelines, inclusion and exclusion criteria ensure rigor. VOSviewer was used for bibliometric mapping and keyword co-occurrence analysis, and studies were thematically categorized to link AI techniques and tools with LIS areas and challenges across the three periods. The review revealed that AI in LIS had progressed from experimental tools to essential components of modern information systems. Three periods were apparent: in 2000-2009, natural language processing (NLP) and artificial neural networks (ANNs) were primarily linked to Information Retrieval (IR); in 2010-2019, AI was most associated with digital libraries and library services; and in 2020-2024, more AI techniques and tools were associated with IR, and library services, particularly in digital and academic libraries to enhance library services and user experience. Unlike prior reviews that focused generally on libraries and specific areas such as information literacy, this study provides a broader analysis of AI techniques and tools across various LIS areas over three periods.

Keywords: Artificial Intelligence, Library and Information Science, Systematic Review, Applications, Challenges

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I. Introduction and Literature Review

Studies have synthesized prior research to review and map the scope and application of artificial intelligence (AI). Reviews on AI reflect the growing scholarly effort to critically examine its applications, ethics, and implications across diverse areas. These reviews reflect AI applications and implications in education (Hwang and Chang, 2023; Labadze et al., 2023), healthcare (Teng et al., 2024; Wilson and Marasoiu, 2022), computer science (Shamsuddoha et al., 2023; Verdecchia et al., 2023) and fashion (Kouslis et al., 2024).

In the Library and Information Science (LIS) area, AI has a significant association with techniques, such as machine learning (ML), deep learning (DL), natural language processing (NLP), artificial neural networks (ANNs), and tools such as chatbot, recommendation systems and robotics, reshaping how information providers deliver services (Aboelmaged et al., 2024; Asemi et al., 2021; Cox and Mazumdar, 2024; Guo et al., 2025; Majhi and Mukherjee, 2023; Noh, 2023). Reviews in the LIS field reflect chatbots in libraries from 2006 to 2023 (Aboelmaged et al., 2024), AI applications in libraries broadly from 2011 to 2020 (Borgohain et al., 2024; Harisanty et al., 2025), AI applications in information literacy (Zhang et al., 2025a) and information ethics (Laine et al., 2024; Zhang et al., 2025b).

Although research on AI is becoming increasingly widespread, there are limited systematic reviews addressing the specific AI methodologies and their association to different areas in the LIS field. Instead, recent AI application reviews have concentrated generally on AI, paying little attention to the application of specific AI techniques and tools on different areas of LIS areas except information literacy, information ethics, and libraries in general. This study therefore broadens the review scope by using systematic review to synthesize and explore studies from the years 2000 to 2024 on applications of different AI techniques and tools in various LIS areas, categorized across the three periods (2000-2009, 2010-2019, 2020-2024).

The research questions are as follows:

RQ1. What are the associations between AI applications and LIS areas across the three periods?

RQ2. What are the challenges of applying AI into LIS areas across the three periods?

II. Methodology

The systematic review followed a structured approach to identify and analyze literature related to the application of AI in LIS. To ensure a comprehensive coverage of relevant literature, data was collected from three major academic databases: Web of Science (WoS), Library, Information Science & Technology

Abstracts (LISTA), and Library Literature & Information Science (LLIS). These databases were selected due to their extensive indexing of LIS and related interdisciplinary research. The search strategy involved using the query term "Artificial Intelligence" in LISTA and LLIS, and same query term in WoS filtered to the area of Library and information science. Only articles published between January 2000 and December 2024 were included in the search. The initial search returned a total of 5,188 records across the three databases. All retrieved articles underwent a manual review of titles and abstracts to assess their relevance and eliminate duplicate entries. This process resulted in a refined dataset of 3,533 unique articles. Subsequently, the remaining articles were assessed to determine their relevance to the intersection of AI and LIS. Studies that did not explicitly address AI applications, theories, or implications within the context of LIS were excluded. This screening phase focused on identifying genuine contributions to the applications of AI to LIS and associated challenges. A total of 220 articles were deemed eligible for inclusion in the final review. Figure 1 presents the PRISMA flowchart of the review process.

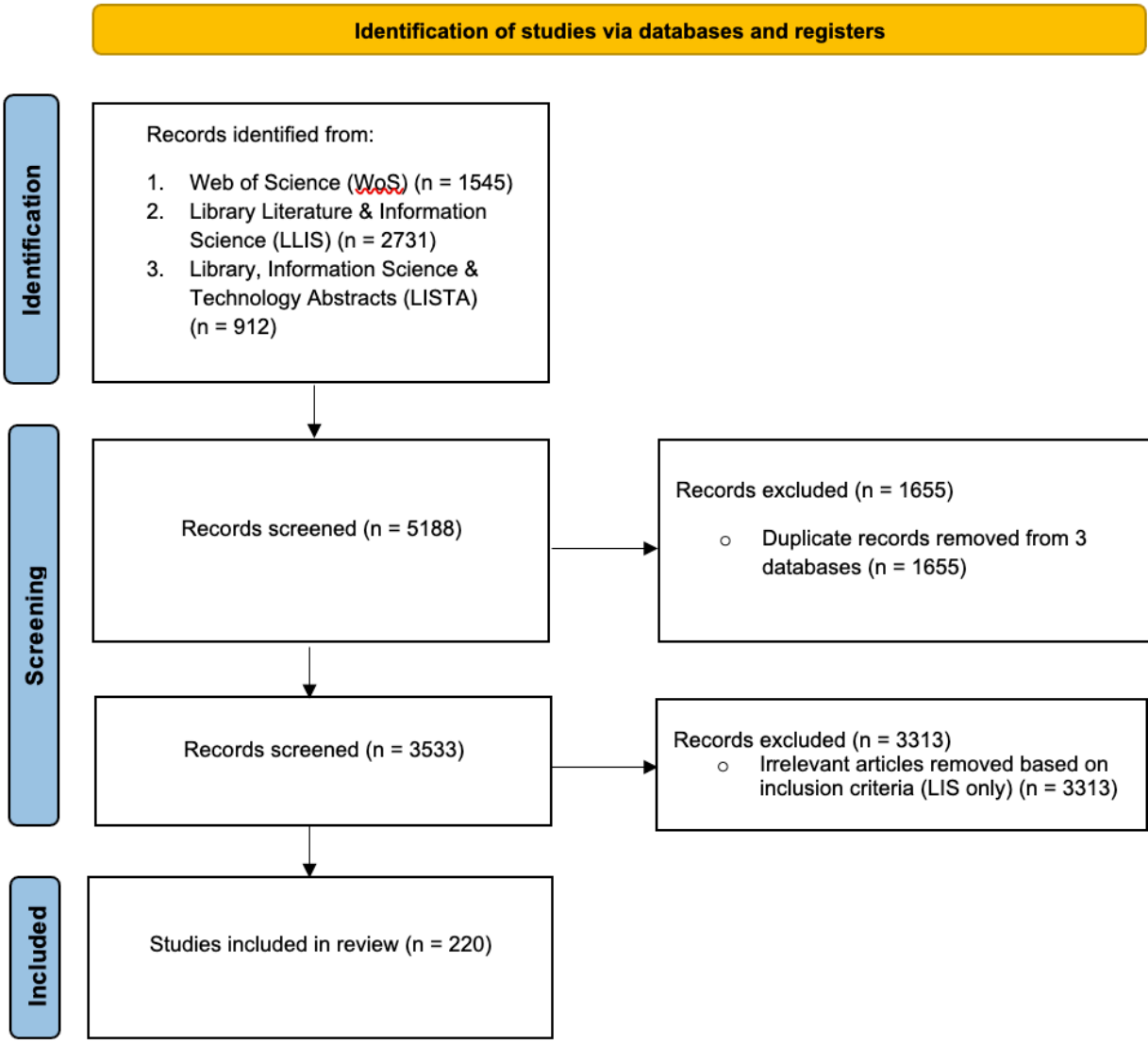

Figure 1. Screening Process

A total of 220 articles were included in this systematic review. Content analysis was conducted to identify and categorize the studies into AI applications in specific LIS areas and challenges identified across the three periods (2000-2009, 2010-2019, and 2020-2024). This method involves examining the frequency, meaning, and associations within the literature to draw meaningful insights and conclusions (Aboelmaged et al., 2024; Brown et al., 2020). To supplement the

analysis and enhance thematic synthesis, we used VOSviewer to conduct keyword co-occurrence and clustering analysis of keywords from the included articles. VOSviewer enabled the identification of conceptual clusters, frequently associated terms, and visual networks of AI applications within LIS in three periods. This quantitative mapping complemented the manual content analysis by revealing high-level patterns and conceptual relationships that may not be immediately evident through interpretive synthesis alone.

III. Research findings

3.1. The associations between AI applications and LIS areas

3.1.1 2000-2009

From 2000 to 2009, the application of AI focuses on six core areas: “Digital Libraries,” “Information Systems,” “Information Retrieval,” “Knowledge Management,” “Library Automation,” and “Metadata and Classification.” They support the curation, description, preservation, and delivery of information resources together through integrated workflows, controlled vocabularies, search methods, and technological infrastructure.

Building on this foundation, researchers turned to AI as a way to expand and refine these core services. The analysis revealed the associations between AI and LIS areas from 2000 to 2009. Figure 2 maps each AI technique into multiple application areas. In the early to mid 2000s, studies focused on AI-driven retrieval and personalization techniques, ANNs and rule-based inference for automated classification, decision-support tools for search, adaptive resonance models and data mining for recommendations, and ensemble transliteration for cross-language retrieval and hybrid ML for answer finding (Frias-Martinez et al., 2006; Oh and Choi, 2006; Ofoghi et al., 2009; Panigrahi and Prasad, 2005; Phillips-Wren and Forgionne, 2006; Tóth, 2002; Tsai and Chen, 2008).

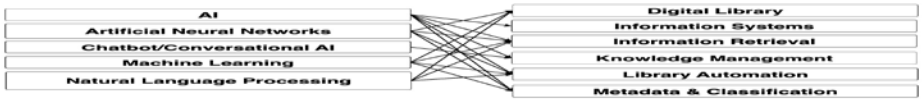

Figure 2. The applications of AI in LIS (2000-2009)

To verify how these AI efforts clustered within the LIS area, findings from VOSviewer showed that the three most common keywords in AI-LIS areas from 2000 to 2009 were “Artificial Intelligence” (f = 23), “Information Science” (f = 10), and “Information Retrieval” (f = 8). Out of the 28 articles retrieved, only 3 featured keywords with a frequency of five or more. Figure 3 displays the clustering of these keywords into a single dominant group. Keywords in the primary cluster (red) include “Artificial Intelligence,” Information Science,” and “Information Retrieval.” This cluster was primarily focused on the early integration of AI techniques into IR systems, emphasizing automated classification via heuristic and neural network models (Tóth, 2002), document organization driven by ML (Panigrahi and Prasad, 2005), and adaptive, user modeling driven by ML for dynamic retrieval and personalization in digital libraries (Frias-Martinez et al., 2006).

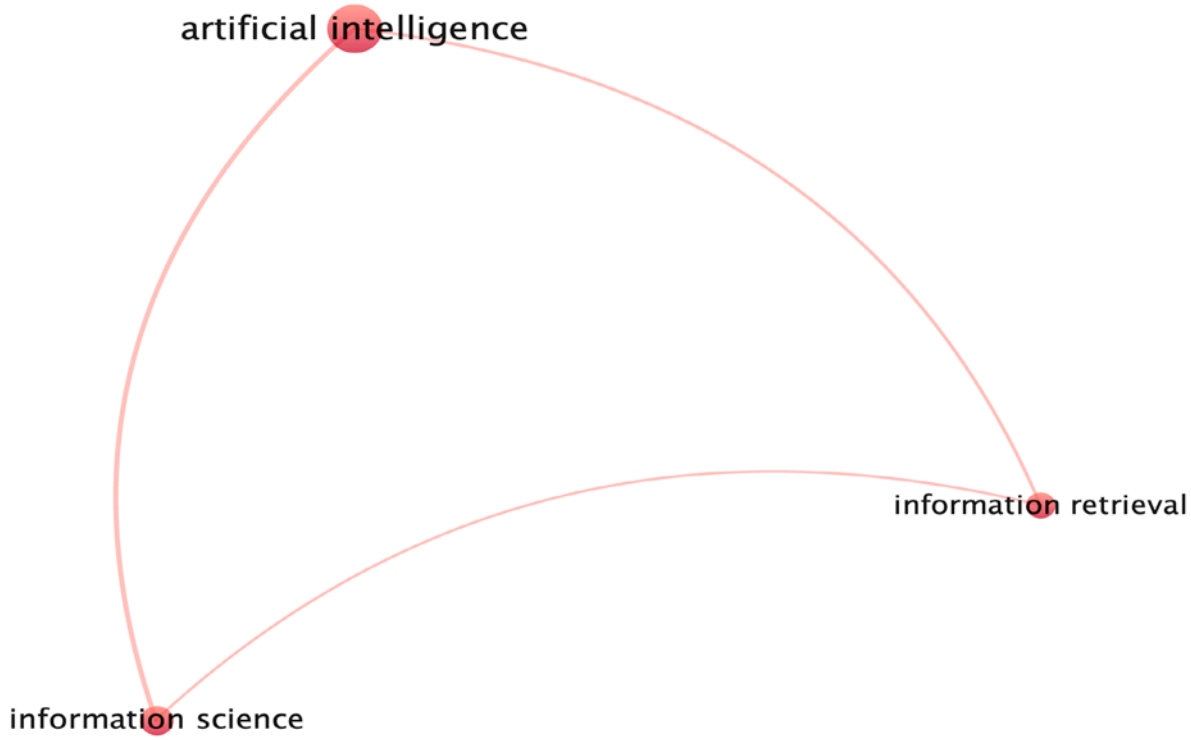

Figure 3. Keywords frequency (2000-2009)

3.1.2 2010-2019

From 2010 to 2019, AI techniques became embedded in many of the LIS areas (see Figure 4). General AI appeared across nearly all areas except "Archives." More specialized techniques and tools mapped onto the particular areas. "Chatbots" and "Conversational AI" were primarily linked to areas such as information literacy, library services (including reference and user services), IR, academic libraries, metadata, and cataloging. "Machine Learning" underpinned large-scale data mining and bibliometric analyses, while "Symbolic AI" played a significant role in archival processing and enhanced both retrieval and knowledge management systems. Among these, "Bibliometrics," "Digital Libraries," "Information Retrieval," and "Library Services" were the LIS areas most strongly connected to AI.

This widespread adoption also reflected an evolution (from foundational frameworks to interactive agents, advanced text analytics, and evaluation

grounded in ethics) in research focus compared with the 2000 to 2009 period. In the early 2010s, scholars focused on knowledge models and Semantic Web technologies to make metadata readable by machine (Benson, 2011; Kåhre, 2013). Attention then turned to conversational interfaces and domain-specific assistants (Allison, 2012; Rubin et al., 2010; Yao et al., 2015). By the mid-2010s, text mining and neural network methods surfaced thematic trends in library literature, which highlighted big data approaches (Zhu et al., 2018). Law librarianship examined intelligent agents that streamlined workflows while raising privacy concerns and underscored librarians' roles in tailoring and deploying AI (Hilt, 2017; Talley, 2016). In the late 2010s, AI-powered chatbots began querying scientific databases, expert surveys showed a maturing area in academic libraries, and work on acceptance and ethics laid groundwork for responsible, human-centered AI (Bohle, 2018; Cox et al., 2019a; Miao, 2019).

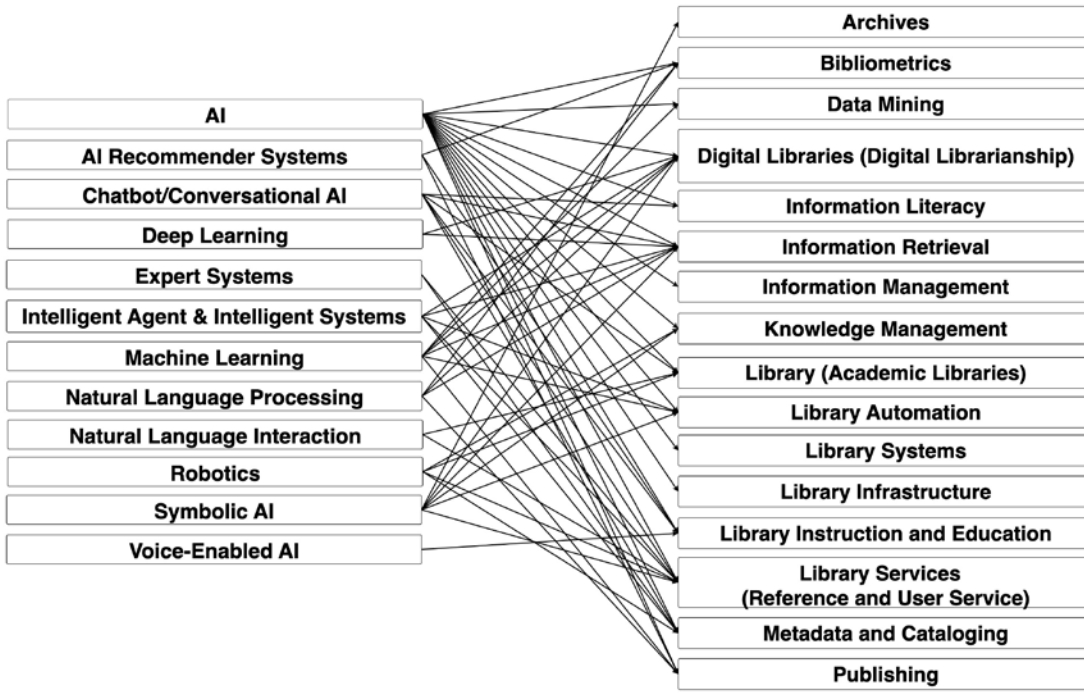

Figure 4. The applications of AI in LIS (2010-2019)

To verify how these AI efforts clustered within the LIS area, findings from VOSviewer showed that the four most common keywords in AI-LIS areas from

2010 to 2019 were "Artificial Intelligence" (f = 34), "Academic Libraries" (f = 6), "Information Retrieval" (f = 6), and "Machine Learning" (f = 6). Out of the 48 articles published during this period, 7 featured keywords appeared at least 5 times. VOSviewer analysis revealed that these terms were grouped into two major clusters (red and green), as shown in Figure 5.

The first cluster (red) includes keywords such as "Artificial Intelligence," "Academic Libraries," "Digital Libraries," and "Machine Learning." This cluster reflected a growing push to integrate AI into library services and infrastructure, which was from environmental scans and discussions on policy and skill to concrete use cases with intelligent agents (Hervieux and Wheatley, 2021; Liu, 2011; Talley, 2016). The second cluster (green) was composed of keywords such as "Artificial Neural Networks," "Information Retrieval," and "Natural Language Processing." This cluster focused on neural and NLP techniques for IR, which covered neural ranking and related methods, cross-language retrieval evaluations, and semantic modeling with Wikipedia features (Craswell et al., 2018; Li et al., 2018; Saif et al., 2018). Such studies highlighted the transition from rule-based AI to learning-based approaches that use NLP, ML, and ANNs to learn patterns from text, which marked a methodological shift in how AI was conceptualized and deployed within LIS. Overall, these clusters illustrated a dual research path in the decade. One stream drives service-oriented AI deployments in academic and digital library contexts, and the other advances in learning-based retrieval using NLP, ML, and ANNs, and related IR approaches.

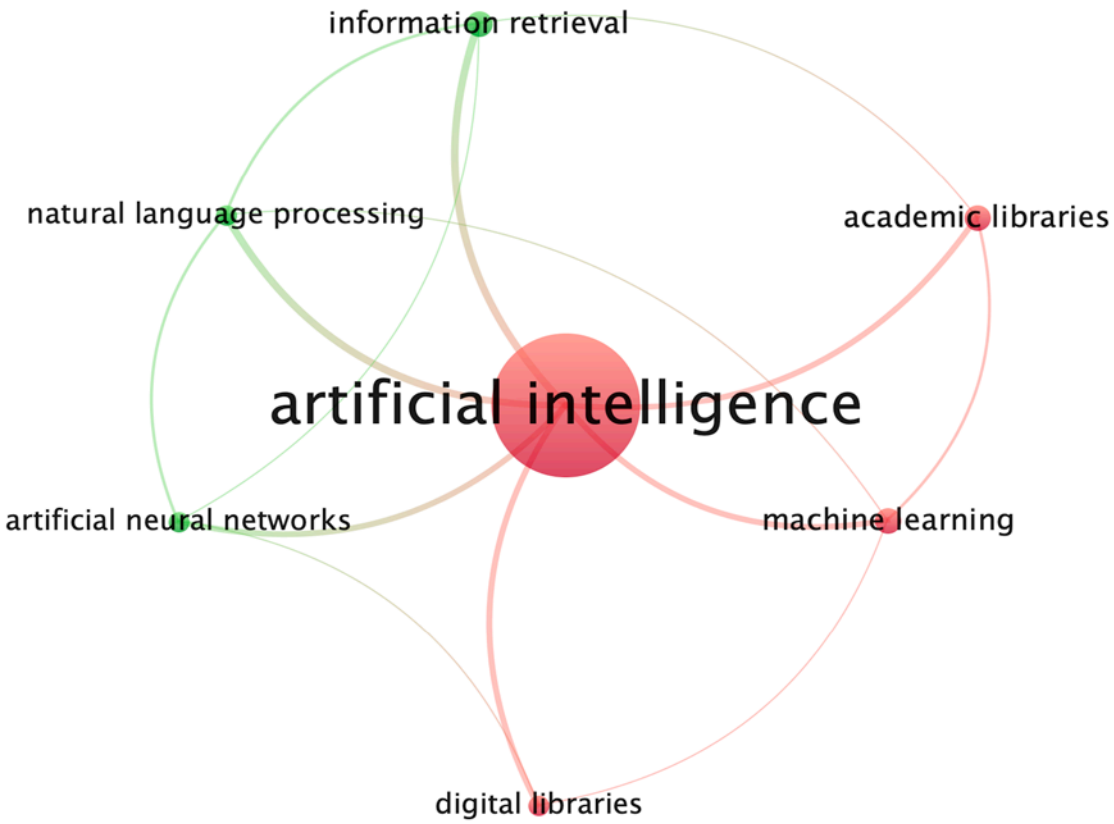

Figure 5. Keywords frequency (2010-2019)

3.1.3 2020-2024

Between 2020 and 2024, AI expanded library workflows through NLP, chatbots, analytics, and text mining, with emerging uses in robotics and image processing, and generative AI supported collaboration, instruction, and LibGuide creation (Ali et al., 2024; Fruehauf et al., 2024).

As Figure 6 illustrates, a notable finding is the link between “Virtual Assistants,” “Academic libraries,” “Digital Libraries,” “Information Literacy,” “Information Retrieval,” “Knowledge Management,” “Metadata and Cataloging,” and “References Service.” Academic libraries, digital libraries, IR, and library services emerged as the LIS areas most frequently integrated with AI technologies. While ML and NLP were applied to academic libraries, librarians in North America expressed cautious optimism toward their application

(Hervieux and Wheatley, 2021; Lund et al., 2020). In addition, university library directors endorsed chatbots and smart recommendation services but emphasized the need for adequate resources and ethical safeguards (Çakmak and Eroğlu, 2024).

Conversational AI had been applied to automate routine information inquiries, extend reference support hours, improved user engagement, and informed emerging knowledge organization and intelligent service frameworks (Aboelmaged et al., 2024; Campbell and Mayhew, 2023; Chen, 2023; Lappalainen and Narayanan, 2023; Yan et al., 2023). This advancement prompted library professionals to confront ethical concerns such as privacy, bias and impacts on equality, diversity and inclusion and underscored the need to uphold core ethical librarianship values and cultivate AI and data literacy (Cox and Mazumdar, 2024). Meanwhile, Kautonen and Gasparini (2024) proposed the B-Wheel model for building AI competencies through design thinking and ethical awareness, and Gupta and Gupta (2023) introduced an experimentation-driven framework to guide the implementation and evaluation of AI integration into library services. This had called for rights-based policy frameworks (Bradley, 2022), enhanced AI and data literacy (Luca et al., 2022), and attention to privacy, bias, and equity (Wójcik, 2021).

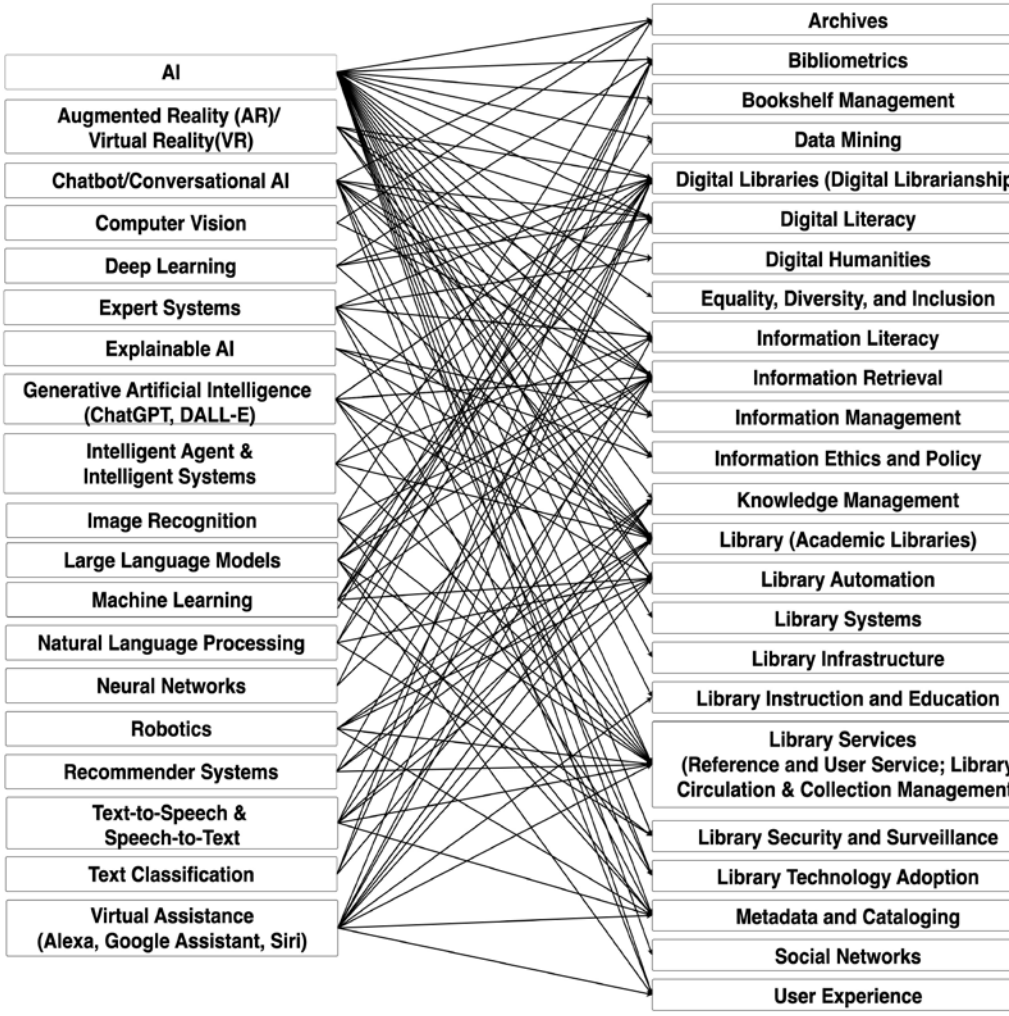

Figure 6. The applications of AI in LIS (2020-2024)

To verify how these AI efforts clustered within the LIS area, findings from VOSviewer showed that AI-related research in LIS grew significantly, with "Artificial Intelligence" (f = 102), "Academic Libraries" (f = 26), "Machine Learning" (f = 18), and "Libraries" (f = 16) emerging as the most common keywords. Of a total of 144 articles, 33 featured keywords that appeared at least five times. VOSviewer analysis revealed six distinct clusters based on keyword co-occurrence, as illustrated in Figure 7.

The first cluster (red) includes keywords such as "Artificial Intelligence," "Academic Libraries," "Academic Librarians," "Big Data," "Education," "Information," "Robots," and "Technology." This cluster encompassed research on AI adoption in academic libraries, which covered management and professional readiness (Abayomi et al., 2020; Hervieux and Wheatley, 2021), strategic and leadership considerations (Huang et al., 2023; Shal et al., 2024), pedagogical and user-centered implementations (Ankamah et al., 2024; Lund et al., 2020), digital transformation trajectories (Adarkwah et al., 2024), and the deployment of intelligent systems and robotics (Asemi et al., 2021; Shahzad et al., 2024). More specifically, generative AI and chatbots had been used in library services for drafting reference responses (Lai, 2023), generating metadata and supporting conversational search interfaces (Lappalainen and Narayanan, 2023), integrating AI into instructional contexts (Johnson et al., 2024), and guiding broader chatbot implementation strategies (Aboelmaged et al., 2024). These studies explored AI applications in libraries, its potentials and challenges, how librarians perceived and responded to them, how AI was incorporated to support library services, and how library infrastructure was evolving to accommodate AI-driven services.

The second cluster (green) features keywords such as "Generative AI," "Information Literacy," "Information Resources," "Information Science," "Librarians," "Library Science," and "Medical Libraries." This cluster was primarily focused on the impact of generative AI on information literacy education, ethical information use, and the evolving role of librarians, particularly in specialized settings like medical libraries (Carroll and Borycz, 2024; Hu et al., 2024; Kautonen and Gasparini, 2024; Liu et al., 2023). Recent studies in this area explored how tools like ChatGPT, language models, and content generation systems influenced users' critical thinking, library resources evaluation and access, and educational frameworks (Fruehauf et al., 2024; Meakin, 2024).

The third cluster (blue) includes terms such as "Colleges," "Digital Technology," "Information Technology," "Library Public Services," "Questionnaires," "Universities," and "User Interfaces." This cluster reflects research on the integration of AI and digital technologies into public-facing and user services in higher education settings. Many studies used surveys, or mixed-method approaches to examine the perspectives of librarians on the awareness and readiness of academic libraries, work performance of librarians, and the applications of AI in the university libraries and AI literacy among academic library employees (Ajani et al., 2022; Asim et al., 2023; Lo, 2024a; Mughari et al., 2024). This line of inquiry is often focused on practical implementation, user experience, and the digital transformation of library services amid rapid technological change (Aboelmaged et al., 2024; Kaushal and Yadav, 2022; Lo, 2024b; Wójcik, 2021).

The fourth cluster (light green) includes terms such as “Algorithms,” “Classification,” “Deep Learning,” “Information Retrieval,” “Machine Learning,” and “Natural Language Processing.” This cluster combined ML-based text classification in LIS and IR evaluation resources (Kragelj and Borštnar, 2021; Shaukat et al., 2022) with related ML applications such as chat reference classification (Wang, 2022); all in all, they illustrated a broader move toward data-centric approaches in and around LIS, with DL playing an increasingly prominent role (Wu et al., 2023).

The fifth cluster (purple) includes terms such as “Bibliometrics,” “Chatbots,” “Libraries,” and “Library Services.” This cluster encompassed bibliometric analyses that charted the growth, thematic trends, and geographic contributions of AI in library research. (Borgohain et al., 2024; Khan et al., 2023; Vasishta et al., 2024). In addition, this cluster also comprised interview-based investigation into chatbot deployment and user interactions within academic libraries (Kaushal and Yadav, 2022), and systematic review synthesizing empirical and conceptual research on library chatbots (Yan et al., 2023). Overall, these streams highlighted a dual emphasis on mapping the landscape of AI in libraries and operationalizing and critically assessing conversational AI tools in library settings.

The sixth cluster (light blue) includes only one term such as “Archives.” This cluster mainly focused on AI-driven techniques in archival practice, including automated content analysis and metadata generation via computer vision; strategies to enrich and unlock metadata in born digital and digitized collections; surveys of AI implementations highlighting metadata extraction and automated description as prominent use cases; frameworks for documenting and auditing AI workflows to ensure transparency and accountability; and assessments of records management professionals’ readiness for AI that reveal optimism about potential applications despite limited hands-on deployment (Craig, 2021; Davet et al., 2023; Jaillant, 2022; Mannheimer et al., 2024; Tsabedze, 2024).

All in all, these six clusters together draw a comprehensive picture of how AI spreads through virtually every facet of LIS research from 2020 to 2024.

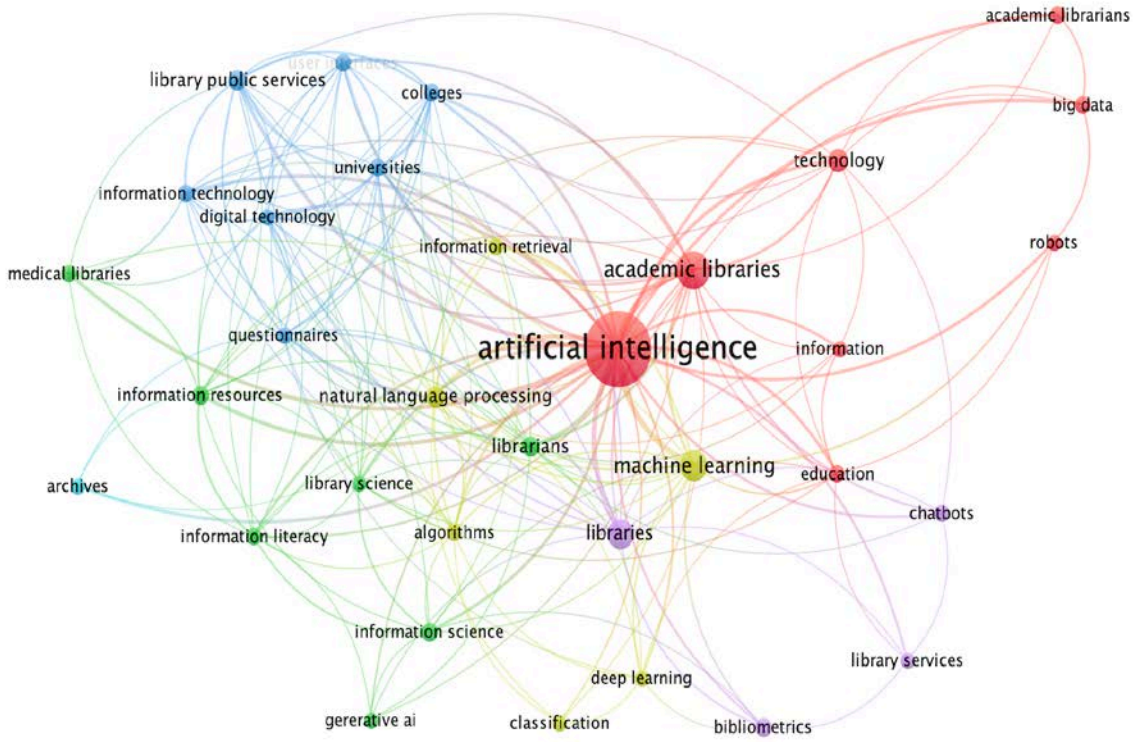

Figure 7. Keywords frequency (2020-2024)

3.2. The Challenges in LIS areas

Despite the clear benefits of AI application in LIS, the findings revealed some challenges categorized as technical obstacles (Çakmak and Eroğlu, 2024; Lawlor, 2019; Liu, 2011; Kragelj and Borštnar, 2021; Tóth, 2002; Yoon et al., 2005), institutional obstacles (Abayomi et al., 2020; Hamad et al., 2023; Molaudzi and Marutha, 2024; Ridley, 2022; Wagner, 2006) and staff obstacles (Bubinger and Dinneen, 2024; Hervieux and Wheatley, 2021; Meakin, 2024), continue to hinder its implementation. The technical obstacles were notably system integration issues, data quality constraints, infrastructure limitations, and algorithmic bias. The institutional obstacles include limited budgets, lack of leadership support, insufficient organizational expertise, ethical and legal concerns. The staff's challenges include staff resistance, fears of job displacement, and low levels of digital and AI literacy.

3.2.1 Types of challenges (2000-2009)

The 2000-2009 period represents the foundational stage of AI integration into the area of LIS. During this decade, AI technologies were still in their infancy, and their applications in LIS remained largely experimental. The challenges faced at this stage were technical and rooted in technological immaturity, methodological uncertainty, and institutional skepticism. de Campos et al. (2004) pointed out that the uncertainty surrounding the use of AI in IR was attributed to the immature state of the technology at the time. Similarly, Yoon et al. (2005) highlighted issues in relying on expert system designs, noting that such systems were often inadequate for achieving broader project goals and recommending more adaptive and flexible design approaches instead. Attempts at automatic classification struggled with limited computing capacity, and converting complex hierarchical schemes into machine-readable features required elaborate rules to resolve ambiguous terms (Tóth, 2002). At the same time, efforts to personalize results held great promise but introduced fresh problems around usability, standardization, scalability, adaptability, and model accuracy when using either user guided or fully automated approaches (Frias-Martinez et al., 2006). Meanwhile, the heavy resource demands of AI and expertise gave rise to what Wagner (2006) called a "knowledge acquisition bottleneck," in which too much expertise remained trapped in people's heads and repositories became hard to maintain.

3.2.2 Types of challenges (2010-2019)

During 2010 to 2019, AI activity in libraries grew, but adoption often stayed at pilot scale as coherent architectures and implementation frameworks were still emerging (Liu, 2011). Practical constraints, such as data and computer demands, also limited reliability and performance in user-facing applications (Lawlor, 2019). This appeared in early library chatbots, which struggled with vague queries and sustained dialogue (Allison, 2012), and in ongoing research challenges around integrating neural information retrieval with established approaches and handling translation ambiguities in cross-language retrieval (Craswell et al., 2018; Li et al., 2018). Personalization and intelligent agents promised more tailored experiences, yet required significant resources and expertise, raised privacy and session control questions, and faltered with exploratory or unstructured queries and the upkeep of domain-specific data (Rubin et al., 2010; Yao et al., 2015).

Meanwhile, studies highlighted major cultural, ethical, and legal concerns, including opacity in decision-making, algorithmic bias, and regulatory gaps (Cox et al., 2019b; Duan et al., 2019; Miao, 2019). These concerns reflected a broader recognition that AI technologies, if left unchecked, could reinforce inequities or undermine trust in libraries. In the library context, these challenges occur because libraries were often excluded from AI research and development initiatives, resulting in limited attention and resources for AI applications in

libraries (Cox et al., 2019b). This marginalization results in fewer investments, limited collaborations with tech industries, and a general lag in adapting library-specific AI solutions. This was an indication that AI adoption in LIS was significantly influenced by organizational and cultural dynamics, with acceptance and success varying markedly across institutions due to differences in institutional values (Duan et al., 2019)

3.2.3 Types of challenges (2020-2024)

The 2020-2024 period was marked by tangible integration efforts, intensified ethical scrutiny, and systemic limitations that shaped the discourse and realities of AI adoption. The challenges during this era were multifaceted, reflecting technical, institutional, and staff obstacles. Technically, the noted challenges identified include poor integration with legacy systems and insufficient infrastructure (Aboelmaged et al., 2024; Cambell and Mayhew, 2023; Echedom and Okuonghae, 2021; Li, 2024; Lo, 2024b). These studies highlighted that many institutions struggled with outdated legacy systems that were incompatible with new AI tools. These difficulties were further compounded by high maintenance costs and unreliable internet connectivity, particularly in developing nations (Aboelmaged et al., 2024; Li, 2024). These technical issues limited not only AI deployment but also its scalability and sustainability in many libraries. Also, AI applications require foundational and robust back-end systems and interoperability standards. Aboelmaged et al. (2024) and Asim et al. (2023) pointed out that the absence of these technical foundations results in suboptimal performance, limiting the utility and reliability of AI systems.

As to institutional barriers, financially, many under-resourced libraries and information providers struggle to adopt AI due to limited budgets, high costs of infrastructure and training, and inability to recruit specialized staff (Abba, 2024; Echedom and Okuonghae, 2021; Islam et al., 2023; Marshall and DuBose, 2024). Additionally, aging systems and lack of leadership support restricted innovation, scalability, and equitable access to AI-powered services. (Çakmak and Eroğlu, 2024; Li, 2024; Shahzad et al., 2024). The ethical implications of applying AI in information access and retrieval were also noted, especially regarding the transparency and accountability of AI-driven decision-making. Studies raised concerns about data privacy, AI bias, misinformation, and the ethical use of AI in information access (Aboelmaged et al., 2024; Bubinger and Dinneen, 2024; Lund et al., 2024; Michalak, 2024; Wójcik, 2021). Similarly, de Leon et al. (2024) observed that academic libraries faced difficulties in ensuring the accuracy and interpretability of AI-generated outputs. These concerns underscored the need for clear ethical frameworks and legal safeguards to guide the responsible use of AI in information services (Bubinger and Dinneen, 2024; Lund et al., 2024).

For staff barriers, resistance to change, lack of AI-related competencies, and fear of job displacement were also reported as obstacles (Bubinger and Dinneen,

2024; Hamad et al., 2023; Harisanty et al., 2024; Kaushal and Yadav, 2022; Wójcik, 2021). For instance, most library staff lacked adequate opportunities for upskilling, creating a gap between AI capabilities and institutional readiness (Ali et al., 2024; Kautonen and Gasparini; 2024; Lund et al., 2024). Staff anxiety over role displacement further worsened change resistance (Abayomi et al., 2020; Bubinger and Dinneen, 2024; Hamad et al., 2023; Molaudzi and Marutha, 2024). This is because information professionals are often apprehensive about the implications of AI for their roles. The absence of institutional strategies to support professional development in AI further aggravated this resistance (Harisanty et al., 2024; Li, 2024; Wójcik, 2021).

IV. Discussion

The findings of the study highlight several notable changes in AI applications to LIS. The evolution of AI research goes from some experimental applications on IR systems in the first period to a wide application to diverse areas of LIS now. Additionally, the number of AI applications in both technologies and LIS applications has dramatically increased across the three periods. The significance of this study can be further discussed in two key areas: the interweaving of two research themes and the uneven application of AI across LIS areas.

One interesting finding is the identification of the interweaving of two research themes: technology advancement and service-oriented innovation. In the first period, AI research in LIS mainly focuses on technology, in which ANNs, rule-based systems, and data mining were applied to improve IR systems and digital libraries (Jörgensen, 2005; Phillips-Wren and Forgionne, 2006; Tsai and Chen, 2008). In the second period, two complementary paths emerged. On the one hand, service-oriented studies concentrated on the application of AI tools in academic libraries to assist cataloging, metadata, and user services (Allison, 2012; Chen and Shen, 2019; Liu, 2011). On the other hand, researchers emphasized technical advancements, in particular NLP and ANNs, to increase search relevance (Craswell et al., 2018). For the third period, the two approaches started to converge, and the line between the two began to blur. More AI applications (e.g., generative AI, chatbots, robotics and AI-powered recommender systems) to academic and digital libraries, IR, and library services further enhanced user experience, information literacy, and metadata creation (Carroll and Borycz, 2024; Kaushal and Yadav, 2022; Wójcik, 2021). Research has also explored institutional reactions from staff, organizations, and ethics. Simultaneously, technological advancement has also progressed including DL, classification, algorithms, and NLP, leading to intelligent system design.

Nevertheless, research on AI applications is not balanced. Majority of the studies show AI applications in academic libraries, and there are still several underexplored LIS areas. The first area is archives and records management in which there is little linkage between AI and archival science, and the association

just started to emerge in the third period. Even though some of the recent studies examined AI in automated description and entity extractions (Craig, 2021; Jaillant, 2022; Mannheimer et al., 2024), archives have limited association with main research of AI applications. Public libraries, which serve diverse user groups, are also detached from AI applications in the three periods. AI tools, such as language translation, inclusive search interfaces, and user engagement tools (Chatzitheodorou et al., 2024; Chemnad and Othman, 2024; Yan et al., 2023), could benefit their diverse users, especially the underrepresented user groups. Additionally, there is a lack of research in special libraries including corporate, law, and government libraries in which AI has much to offer from business intelligence to legal support. While users are involved in studies related to chatbots and recommender systems, the research mostly focuses on the functionality of the systems rather than user needs, behaviors, and their emotional and affective feedback. Finally, while ethical concerns were identified, broader information policy and standards needed to be further examined and discussed (Cox and Mazumdar, 2024; Kautonen and Gasparini, 2024).

Based on the systematic review, three main challenges were identified: technical barriers, institutional barriers, and staff barriers. The main technical barriers were associated with the compatibility between legacy systems and AI systems or tools (Aboelmaged et al., 2024). To address the challenges, institutions can implement middleware solutions and APIs that enable AI tools to work with existing systems. At the same time, libraries should prepare for transitioning to cloud-based or open-source platforms that are more compatible with AI applications. It is essential to collaborate with system vendors to develop customized solutions to support AI compatibility. Most importantly, it is also helpful to engage in communities or forums to share best practices of AI applications. These strategies can support a more seamless and sustainable path toward adoption of AI tools in LIS environments.

Institutional barriers were mainly connected to cost (Abba, 2024; Echedom and Okuonghae, 2021). Financial constraints can be resolved at different levels: institutions can share resources within their consortia, grant applications, and partnerships with universities, nonprofits, or tech companies offering subsidized or open-source AI solutions. Institutions can also prioritize cost-effective AI tools and focus on step-by-step adoption, starting with low-risk, high-impact projects. To address leadership awareness issues, AI awareness training for administrators should be done first. Simultaneously, institutions need to integrate AI into organizational strategic plans and align the adoption of AI tools with institutional missions. Additionally, institutional AI policies need to be developed to take ethical concerns into consideration.

The staff barriers to AI adoption were related to resistance to change, lack of AI-related competencies, and fear of job displacement (Bubinger and Dinneen,

2024; Hamad et al., 2023). To overcome these challenges, we can take three approaches. First, it is critical to involve library and information professionals in the early discussion of AI adoptions and their benefits and drawbacks. Second, enhance AI knowledge and skills of library and information professionals by offering training programs and certifications. It is also essential to integrate AI technology into LIS curricula. Third, further research needs to explore how to use AI tools as an extension of staff expertise rather than a replacement. The more staff understand and incorporate AI tools into their work, the more likely they will adopt AI in the LIS field. Further research is also needed to examine AI adoption among both users and library and information professionals.

V. Conclusion

This systematic review provides a comprehensive understanding of the applications of AI in the LIS field and the challenges encountered from 2000 to 2024. The study reveals a significant shift from early experimental uses of AI in basic retrieval and classification tasks to more advanced AI technologies embedded across diverse LIS areas. The review identifies clear trends, reflecting how AI has become a core part of academic and specialized libraries, knowledge management, literacy, and digital preservation and publishing. The challenges identified are summarized as technical obstacles, institutional obstacles, and staff obstacles. Despite these challenges, the growing integration of intelligent systems into LIS presents a promising path for innovation in library and information services.

Although this systematic review aims to offer a comprehensive synthesis of AI applications in LIS, it is important to acknowledge some limitations which could influence the interpretation of our findings. The study only relied on databases such as WoS, LISTA, and LLIS as its literature source, potentially overlooking relevant research indexed in other LIS databases. Additionally, the search terms and filters, though designed to capture key AI in LIS papers, may have inadvertently excluded some relevant works. Future research should consider expanding the database coverage to include additional sources to capture a broader scope of literature. Moreover, incorporating text mining or NLP techniques can enhance the depth of analysis by uncovering latent themes and trends in the application and implications of AI in the LIS area.

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