Application of Artificial Intelligence in Information Retrieval for Academic Research: A Systematic Literature Review Using PRISMA

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ABSTRACT

This study presents a systematic review on the integration of Artificial Intelligence (AI) in academic research, with particular emphasis on its applications, benefits, and challenges in information searching and retrieval. Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, 41 eligible articles published in 2024 were selected from Elsevier's ScienceDirect and Google Scholar for analysis. The review reveals that AI's role in academic research is closely linked to advancements in machine learning and data mining, particularly in the domain of information retrieval. Although the number of studies specifically addressing AI's influence on academic research practices remains limited, findings indicate a growing interest in leveraging AI to enhance research methodologies and outcomes. A significant portion of the reviewed literature focuses on practical implementations of AI, especially machine learning, in academic libraries, highlighting AI's potential to improve library operations and information services. Furthermore, the review identifies recurring themes around the benefits and limitations of AI in information retrieval, reflecting both opportunities and ongoing challenges in the field. Notably, research gaps were found in areas that explore the intersection of AI, information retrieval, and academic research practices, offering promising directions for future investigation. It is recommended that researchers further explore how AI can support innovative approaches in academic research, data analysis, and scholarly communication. Institutions such as libraries can leverage existing literature as a guide for adopting AI-driven tools to improve service delivery and research support.

Keywords: AI, Academic Research, Information Retrieval, PRISMA & Machine Learning.

1.0 Introduction

Academic life is incomplete without research, as it enhances students' and researchers' analytical and critical thinking skills while deepening their understanding of chosen subjects. According to Ezra (2020), academic research is a multistep process aimed at answering research questions. It involves the systematic study of a particular topic or issue using appropriate methodologies, ultimately leading to meaningful recommendations or solutions. Bouchrika (2024) also emphasizes that academic research extends beyond scholarly inquiry, it plays a crucial role in expanding knowledge and solving real-world problems.

To conduct effective research, scholars must engage with existing literature, retrieving relevant information from diverse sources. These include search engines (e.g., Google, Google Scholar, Bing, DuckDuckGo), digital libraries (e.g., institutional repositories, Koha, Calibre, Greenstone), and academic databases (e.g., ProQuest, Ebrary, Springer, ScienceDirect, Scopus, PubMed, IEEE Xplore). These platforms facilitate access to books, articles, and multimedia, enabling researchers to identify, retrieve, and evaluate relevant materials.

Information retrieval (IR) plays a foundational role in this process by enabling the discovery, access, and use of knowledge resources. Saheb and Izadi (2019) define IR as the process of obtaining relevant information from large collections of resources based on a user's query. It focuses on identifying documents, datasets, or multimedia that meet a user's specific information need. As such, IR forms the bridge between researchers and data in the digital age. Advanced querying techniques, including Boolean operators, natural language processing, and keyword searches, have significantly improved IR outcomes.

However, the exponential growth of digital content has led to an "information overload," making it increasingly difficult for researchers to navigate the vast body of academic literature. This surge has created a demand for more sophisticated filtering and retrieval mechanisms. As both academic and commercial information repositories expand, there is a growing need for efficient and precise systems capable of handling structured and unstructured content across various formats including text, images, audio, and video.

To address these challenges, artificial intelligence (AI) technologies such as machine learning, natural language processing (NLP), deep learning, and knowledge graphs are now being integrated into modern IR systems. Traditional search techniques often fall short of meeting the complex needs of today's researchers. AI integration offers enhanced search capabilities, increased efficiency, and improved relevance in information retrieval (Luo et al., 2020).

AI has thus become a transformative force in academic research. Its integration into IR systems enables more scalable, accurate, and intelligent data processing and decision-making. AI refers to the simulation of human intelligence in machines, allowing them to learn, reason, solve problems, perceive, understand language, and interact with users. It draws from various disciplines, including computer science, mathematics, statistics, engineering, and cognitive psychology (Craig, Laskowski, & Tucci, 2024, October 1).

Historically, the concept of AI dates back to the 1950s when Alan Turing proposed a test

to assess a machine's ability to exhibit intelligent behavior (Kleppen, 2023). The term "Artificial Intelligence" was officially coined in 1956 by John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon. During this period, the first AI program, The Logic Theorist, was also developed. In subsequent years, rule-based expert systems, machine learning, and neural networks emerged (Kleppen, 2023).

However, AI development experienced a decline between the 1980s and early 2000s a period often referred to as the "AI Winter" due to criticism and limited funding (Toosi et al., 2021). From the 2000s onward, AI experienced a resurgence, driven by advances in deep learning and increased access to data and computing power (Perifanis & Kitsios, 2023). These developments have significantly increased AI's visibility and applicability in research, particularly in the field of information retrieval.

1.1 Statement of the Problem

The exponential growth of academic research has intensified the demand for efficient information retrieval systems to manage vast volumes of data. AI offers transformative potential in enhancing these systems by improving the accuracy, speed, and accessibility of information. However, despite its promise, the integration of AI in academic research is accompanied by challenges such as data biases, ethical concerns, technical complexities, and uneven adoption across disciplines.

While existing studies explore individual aspects of AI's application, a comprehensive understanding of its benefits (Sampath, et al., 2024), challenges, and overall role in information retrieval remains fragmented (Knowledge Institute, 2025). This gap in knowledge hinders the development of optimal AI-driven solutions for academic research. Therefore, a systematic investigation using PRISMA is essential to consolidate existing literature, analyze the interplay of these variables, and provide actionable insights for advancing the application of AI in academic environments.

AI applications are redefining academic research by improving accuracy, efficiency, and accessibility in information retrieval. These innovations empower researchers to navigate and synthesize vast amounts of data with minimal effort. But it has been observed by the researchers that, despite the significant advancements in artificial intelligence, the applications, benefits, and challenges of its use in academic information retrieval remain poorly synthesized, creating gaps in understanding its full potential and limitations. Based on this, the Research Objective (RO) to be answered in this study are as follows:

1.2 Research Objectives

1. Identify AI applications in academic research focused on information retrieval.
2. Evaluate the benefits of AI applications in academic research focused on information retrieval.
3. Examine challenges exist in adopting AI for academic research, particularly in information retrieval.

2.0 Research Methods

The research method adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guidelines (PRISMA Statement, 2024) to ensure transparency, replicability, and methodological rigor. The systematic review involved defining article selection criteria,

search strategies, data extraction, and analytical procedures. Searches were conducted using the Elsevier (ScienceDirect) database and Google Scholar with relevant keywords such as "artificial intelligence," "information retrieval," "research," and "applications."

Initially, the review aimed to cover studies published between 2022 and 2024. However, during the initial screening phase, the search produced an unmanageably large number of results, many of which overlapped in content, lacked methodological rigor, or did not directly address the core intersection of artificial intelligence and information retrieval in academic research. To enhance the focus and feasibility of the review, the timeframe was deliberately narrowed to include only articles published in 2024.

This adjustment ensured the inclusion of the most current research reflecting recent trends, technologies, and developments in the rapidly evolving field of AI. Focusing solely on 2024 publications allowed for a deeper, more targeted analysis while maintaining alignment with the study's objective to capture emerging patterns, applications, and challenges. Though this reduced the number of articles reviewed, it enhanced the review's relevance and timeliness without compromising the representativeness or balance of perspectives. The final selection of articles was filtered through PRISMA's eligibility criteria to ensure quality, relevance, and thematic alignment.

In line with PRISMA, the systematic review followed these core steps:

1. Identification of data sources;
2. Study selection based on inclusion/exclusion criteria;
3. Data collection and extraction;
4. Determination of study eligibility;
5. Selection of data items for analysis.

2.1 Determination of Information Sources:

The information search was conducted using two major academic repositories: Elsevier (ScienceDirect) and Google Scholar. These platforms were chosen due to their comprehensive coverage of peer-reviewed journal articles, book chapters, and conference papers across disciplines, including computer science, information science, and research methodologies. The selection ensured a diverse and credible body of literature to assess the integration of Artificial Intelligence (AI) in information retrieval for academic research.

2.2 Study Selection:

To ensure systematic and unbiased article selection, the following multi-phase process was adopted:

1. Keyword Search: Initial search queries were formulated based on the research objective to explore AI applications in academic research with a focus on information retrieval. Keywords included:

   (a) "AI application," "Academic Research," "Information Retrieval,"
   (b) "Information Retrieval Systems," "Machine Learning in Research,"
   (c) "Natural Language Processing," "AI Benefits in Information Retrieval,"
   (d) "Ethical Challenges in AI," "AI Limitations in Academic Research,"
   (e) "AI-driven Research Tools," "Impact of AI on Research Productivity,"

(f) "Semantic Search with AI". These were combined with terms like "quantitative," "qualitative," and "mixed method" using Boolean operators for refinement.

2. Preliminary Screening: Titles, abstracts, and keywords were assessed for relevance based on the predefined eligibility criteria.
3. Full-Text Review: Articles passing the initial screening were reviewed in full to ensure alignment with the research focus.
4. Reviewer Validation: The selection process was conducted independently by two reviewers. Discrepancies in article inclusion were resolved through discussion and consensus. In cases of persistent disagreement, a third reviewer was consulted.

2.3 Data Collection Process and Eligibility Criteria

Data extraction was conducted manually using a structured extraction form. The process captured the following elements from each article: author(s), title, year of publication, journal, research methodology, type of AI application, key findings, and relevance to information retrieval in academic research. The process was facilitated using Microsoft Excel to organize, categorize, and compare data for consistency.

The inclusion criteria (IC) applied were:

i. IC1: Articles published in English and peer-reviewed.
ii. IC2: Studies focusing on the application, benefits, or challenges of AI in academic research, specifically within the domain of information retrieval.
iii. IC3: Research employing quantitative, qualitative, or mixed-methods approaches.

These criteria ensured that only high-quality, relevant, and methodologically sound studies were included. Articles that were inaccessible in full text or did not meet at least two of the criteria were excluded.

2.4 Selection and Categorization of Data

Articles were categorized using the following attributes:

a) Year of publication
b) Author(s)
c) Research methodology
d) Key variables investigated
e) Findings on AI application, benefits, and challenges in information retrieval

The initial keyword search yielded approximately 1,372,000 results. Due to the vast volume and recurring content, the search scope was refined to include only publications from 2024, resulting in 269,166 results. This refinement helped target the most recent developments and trends, allowing for a more focused and meaningful review.

From this pool, 409 potentially relevant studies were identified through abstract and keyword screening. After full-text evaluation using the eligibility criteria, 41 empirical articles were selected for final synthesis. These articles formed the basis of the thematic analysis and discussion on the state of AI in academic information retrieval.

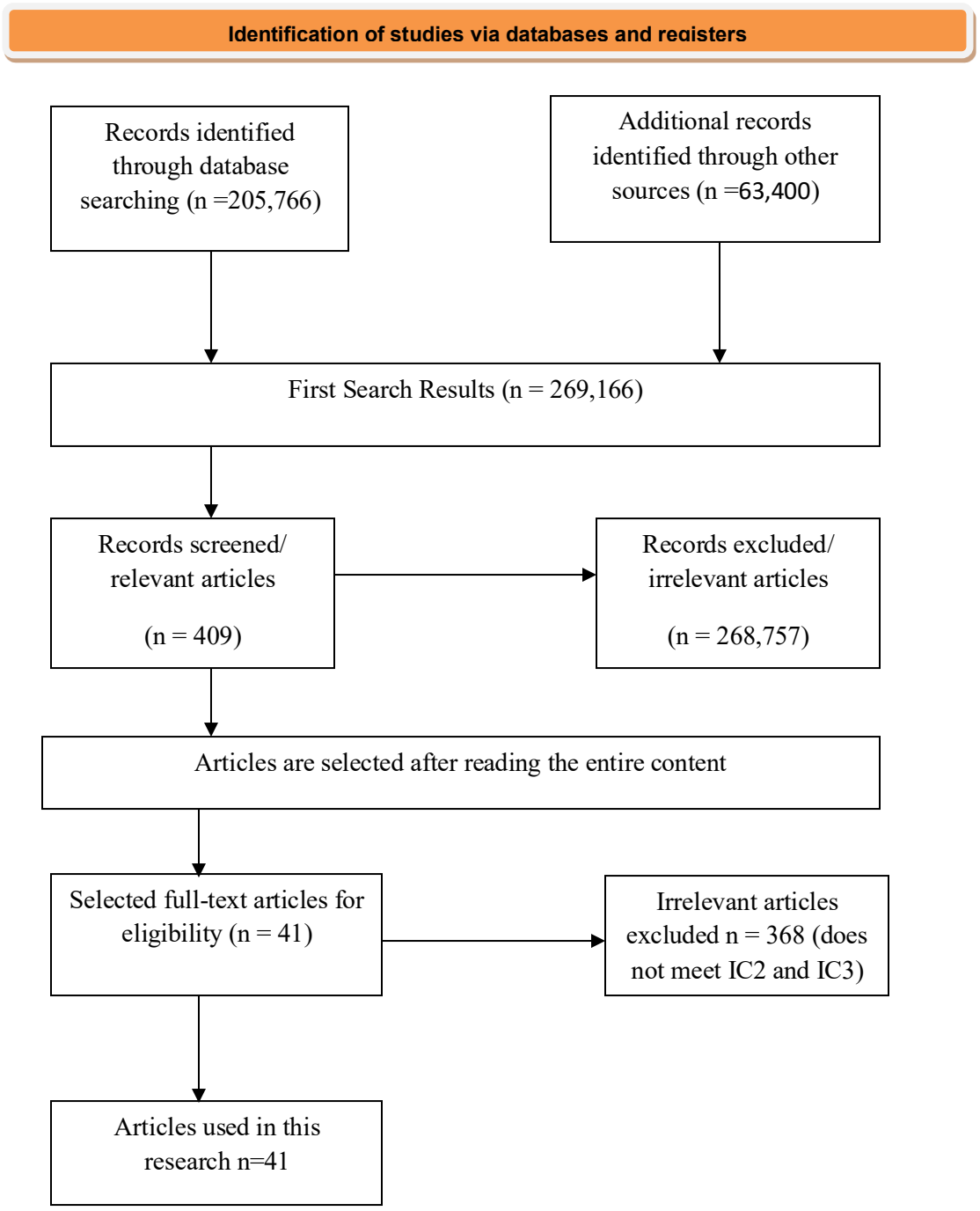

Fig. 1. *Adapted PRISMA flow diagram for Systematic Reviews*

3.0 Results and Discussion

3.1 Screening Process and Article Categorization

Following the PRISMA guidelines, the initial database and search engine queries yielded approximately 1,372,000 results. Due to the large volume and frequent duplication across years, the scope was narrowed to articles published in 2024 only, yielding 269,166 results. Screening by title and abstract reduced the dataset to 409 potentially relevant articles. After full-text evaluation using inclusion criteria (language, focus on AI in academic research/information retrieval, empirical method), 41 articles were retained for the final analysis.

A manual content analysis approach was employed to categorize the 41 articles. Themes were developed using open coding, where two independent reviewers read each article thoroughly and identified recurring patterns and keywords. Through iterative coding and discussion, four key themes were established based on both the frequency of discussion points and thematic relevance to the research objectives:

(a) AI and Information Retrieval in Research (10 articles)
(b) AI and Academic Research Methodologies (9 articles)
(c) AI in Academic Libraries and Machine Learning in Research (11 articles)
(d) AI Benefits and Limitations in Research Contexts (11 articles)

Any discrepancies in thematic assignment were resolved through consensus discussions. A coding log was maintained using Microsoft Excel, which tracked article metadata and thematic tags.

3.2 Quality Appraisal of Included Studies

To assess methodological quality, the included studies were evaluated using the Mixed Methods Appraisal Tool (MMAT). The appraisal considered:

1) Clarity of research questions
2) Appropriateness of methodology
3) Validity of data collection methods
4) Transparency in analysis
5) Relevance to research objectives

Approximately 70% of the included studies met four or more quality indicators, reflecting a moderate to high level of methodological robustness. However, a few studies lacked clarity in sampling strategies or detailed analytical procedures, which were noted in the synthesis as limitations affecting generalizability.

3.3 Thematic Findings and Synthesis

Theme 1: AI in Information Retrieval (10 studies)

These studies consistently showed that AI enhances the precision, efficiency, and personalization of academic search processes. For example, AI-driven semantic search tools and natural language processing (NLP) algorithms improve the understanding of user intent and query context (Wang et al., 2022; Dai et al., 2023). Personalized recommendation systems based on user behavior patterns were also a frequent application (Jannach et al., 2019; Zhao et al., 2020).

Theme 2: AI and Academic Research Methodology (9 studies)

This theme focused on AI's contribution to automating literature reviews, identifying research gaps, and formulating hypotheses through pattern recognition (Kim et al., 2021). However, findings also revealed limited depth in integrating AI into core research design stages, such as methodology formulation and data interpretation, highlighting this as an emerging area of interest.

Theme 3: AI in Academic Libraries and Machine Learning (11 studies)

These articles emphasized the operational integration of AI tools in library services, such as automated indexing, reference management, and digital archiving. Machine learning models were commonly applied in library recommender systems and user behavior analytics (Alonso et al., 2021). This high number of studies suggests a strong focus on practical implementations of AI in academic institutions.

Theme 4: Benefits and Limitations of AI in Academic Research (11 studies)

These studies provided a critical lens on AI's potential. Reported benefits included time savings (Kumar et al., 2018), improved search accuracy (Singh & Jain, 2020), and the ability to process large datasets (Li et al., 2023). However, significant challenges were noted, particularly regarding:

(a) Bias and Fairness: AI systems often reflect the bias present in their training data (Bender et al., 2021).
(b) Interpretability: Many models operate as "black boxes," complicating their use in sensitive fields (Lipton, 2018).
(c) Data Privacy: Ethical concerns around user data remain unresolved (Veale et al., 2018; Barocas & Selbst, 2016).
(d) Quantitatively, about 75% of the studies acknowledged data quality or bias concerns, 60% highlighted model interpretability issues, and 50% discussed ethical risks such as privacy and accountability.

3.4 Trends and Cross-Theme Patterns

Analysis of the 41 studies revealed several noteworthy trends:

1) Growth of applied AI: There was a stronger emphasis on applied tools (e.g., chatbots, recommender systems) than on theoretical or conceptual explorations of AI in academia.
2) Fragmentation of research: Few studies examined integrated workflows, where AI tools support the full research lifecycle (from problem identification to dissemination).
3) Disciplinary spread: Most studies came from information science, computer science, and library science, with limited representation from education or the social sciences, pointing to a need for more interdisciplinary investigations.
4) Lack of critical appraisal: Only a minority of studies conducted formal ethical or evaluative assessments of the AI tools used, which weakens the reliability of their claims.

However, while distinguishing background literature from review findings, it revealed that some cited works (e.g., King et al., 2019; Lipton, 2018; Chen et al., 2020) were included as background literature to

contextualize the study's aims, rather than being part of the 41 reviewed articles. For clarity, we have now explicitly distinguished between:

a. Systematically reviewed studies (2024 publications selected)
b. Background literature (pre-2024 or theoretical contributions).

This identify which insights stem from the current systematic review and which are derived from broader literature.

4.0 Implications of Findings

The selection and analysis of 41 empirical studies provide critical insights into the current landscape of research concerning artificial intelligence (AI) in information retrieval and academic research. The thematic categorization of the studies revealed distinct areas of focus with varying degrees of scholarly attention.

Notably, a moderate number of studies focused on the application of AI in information retrieval systems, underscoring its role as a foundational and widely adopted use case. This suggests that AI's ability to improve search accuracy, user intent prediction, and data accessibility remains central to its academic utility.

Conversely, the relatively lower number of studies exploring AI's role in academic research methodologies points to an emerging and underdeveloped area. This thematic gap highlights a significant opportunity for future research to investigate how AI can systematically transform the design, conduct, and dissemination of scholarly work.

Interestingly, the largest group of studies examined practical implementations of AI in academic libraries and machine learning in research, reflecting strong interest in operational and applied AI technologies. This indicates a trend toward real-world deployments and suggests that libraries are increasingly positioning themselves as innovation hubs for AI integration.

Another prominent theme involved the benefits and limitations of AI in academic contexts. These studies critically examined both the advantages, such as scalability, efficiency, and precision, and the challenges, including bias, lack of transparency, and ethical concerns. The prominence of this theme demonstrates the field's recognition of the dual-edged nature of AI technologies.

The synthesis also revealed notable research gaps. Few studies explored the systematic integration of AI into broader academic workflows, such as peer review, publication ethics, or collaborative research environments. Furthermore, there was limited engagement with ethical, organizational, and social dimensions, which are crucial for responsible AI adoption. This points to a need for more interdisciplinary research that incorporates perspectives from information science, computer ethics, and policy studies.

Furthermore, the diversity and fragmentation of topics suggest that the field is still in a nascent stage of development, with many isolated strands of inquiry. This reinforces the value of conducting systematic reviews like the present one, which help consolidate scattered findings and provide a clearer roadmap for future investigation.

5.0 Conclusion

This systematic literature review explored the evolving role of artificial intelligence (AI) in academic information retrieval and research

practices. Using clearly defined eligibility criteria and the PRISMA framework, 41 peer-reviewed articles published in 2024 were selected and analyzed. The findings reveal that AI technologies significantly enhance the efficiency, accuracy, and scalability of information retrieval processes. Moreover, AI is being increasingly integrated into academic libraries and research environments, supporting tasks such as automated indexing, literature summarization, and personalized recommendations.

Despite these advances, the review identified several critical gaps. Particularly, there is limited research on the integration of AI into the core methodological processes of academic research, such as hypothesis generation, research design, and ethical evaluation. Also, challenges related to bias, interpretability, and data privacy remain under-addressed in much of the literature.

This review highlights the need for interdisciplinary research that bridges technical innovations with academic and ethical considerations. Future studies should aim to evaluate the effectiveness of AI tools across disciplines, investigate their impact on research quality, and develop frameworks for responsible and transparent AI use in scholarly contexts. Overall, the findings offer a foundation for future inquiry and policy development, while also providing direction for researchers seeking to explore the transformative potential and limitations of AI in academic environments.

5.1 Recommendations

Based on the findings of this review, the following recommendations are proposed:

1. Future research should focus on how AI can be effectively integrated into core academic research processes, including methodology design, data analysis, peer review, and publication workflows. This includes developing frameworks that ensure transparency, ethical use, and replicability of AI-driven methods in academic settings.
2. Libraries, research centers, and higher education institutions should leverage existing literature and best practices to guide the adoption of AI-powered tools. These tools can be used to enhance information retrieval systems, automate metadata generation, support personalized research assistance, and improve user experience.
3. Stakeholders should collaborate in establishing standards and policies for responsible AI use in academia. This includes addressing issues of data privacy, algorithmic bias, and system interpretability to foster trust and accountability in AI applications.

References

Alonso, O., et al. (2021). "Semantic search: Bridging the gap between users and information." *Journal of Information Retrieval*, 24(3), 287-302.

Barocas, S., & Selbst, A. D. (2016). "Big Data's disparate impact." *California Law Review*, 104(3), 671-732.

Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the dangers of stochastic parrots: Can language models be too big? *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency*.

Binns, R. (2018). "Fairness in machine learning: Lessons from political philosophy." *Proceedings of the 2018 Conference on Fairness, Accountability, and Transparency*, 149-158.

Blei, D. M., et al. (2017). "Probabilistic topic models." *Communications of the ACM*, 55(4), 77-84.

Chen, L., et al. (2019). "AI for big data: Applications and challenges." *Journal of Big Data*, 6(1), 1-12.

Craig, L., Laskowski, N., & Tucci, L. (2024, October 1). *What is AI? Artificial Intelligence explained*. Search Enterprise AI. https://www.techtarget.com/searchenterpriseai/definition/AI-Artificial-Intelligence.

Dai, Z., et al. (2023). "Automated literature review using AI: A systematic approach." *Information Processing & Management*, 60(2), 102200.

Doshi-Velez, F., & Kim, B. (2017). "Towards a rigorous science of interpretable machine learning." *Proceedings of the 2017 ICML Workshop on Human Interpretability in Machine Learning*, 1-5.

Gupta, S., et al. (2022). "AI-based approaches to improve information retrieval." *Journal of Computational Science*, 54, 102680.

Jannach, D., et al. (2019). "Recommender systems: Challenges and future directions." *ACM Transactions on Intelligent Systems and Technology*, 10(4), 1-32.

Jobin, A., et al. (2019). "Global landscape of AI ethics guidelines." *Nature Machine Intelligence*, 1(9), 389-399.

Kim, Y., et al. (2021). "Trends in literature reviews: A systematic approach using AI." *Research Synthesis Methods*, 12(3), 396-411.

Kleppen, E. (2023, December 22). *What Is the Turing Test?* Built In. https://builtin.com/artificial-intelligence/turing-test

Knowledge Institute. (2025, June 11). *The challenge of information retrieval in enterprise AI*. Retrieved from https://www.infosys.com/iki/perspectives/information-retrieval-enterprise-ai.html

Kumar, V., et al. (2018). "Efficient information retrieval in the era of AI." *ACM Computing Surveys*, 51(3), 1-34.

Li, X., et al. (2023). "Scalable AI systems for big data retrieval." *IEEE Transactions on Knowledge and Data Engineering*, 35(2), 124-138.

Lipton, Z. C. (2016). "The mythos of model interpretability." *Communications of the ACM*, 59(10), 36-43.

Luo, J., et al. (2020). "AI and information retrieval: A comprehensive review." *Journal of Information Science*, 46(3), 331-346.

Moher, D., et al. (2015). "Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement." *PLOS Med*, 6(7), e1000097.

Nguyen, T. T., et al. (2021). "The role of AI in enhancing search efficiency." *ACM Transactions on Information Systems*, 39(4), 1-30.

O'Neil, C. (2016). *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. Crown Publishing Group.

PRISMA statement. (2024) PRISMA Statement. https://www.prisma-statement.org/

Sampath, K. K., Ranjan, K., Avula, V. A., Ratkanthiwar, M. S., Kondagurle, M. R., Agashe, P. A., & Zende, S. S. (2024). The Role of Artificial Intelligence in Enhancing Information Retrieval Systems in Academic Libraries. *Library Progress International, 44*(3), 22526-22541.

Singh, R., & Jain, P. (2020). "Improving accuracy in information retrieval using AI." *Journal of Data Science and Analytics*, 5(1), 25-37.

Sweeney, L., et al. (2020). "Data mining for social good: Opportunities and challenges." *Data Mining and Knowledge Discovery*, 34(2), 504-531.

Toosi, A., Bottino, A. G., Saboury, B., Siegel, E., & Rahmim, A. (2021). A Brief History of AI: How to Prevent Another Winter (A Critical Review). *PET Clinics*, *16*(4), 449–469. https://doi.org/10.1016/j.cpet.2021.07.001

Wang, L., et al. (2022). "AI-enhanced semantic search in digital libraries." *Journal of Digital Information*, 23(1), 56-78.

Zhao, Y., et al. (2020). "Personalized recommendation systems: A review." *ACM Computing Surveys*, 53(4), 1-35.