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The Implementation of AI-Based Information Retrieval System at the University of North Sumatera Library

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ABSTRACT

This study examines the implementation of an artificial intelligence (AI)–based information retrieval system at the University of North Sumatra (USU) Library. The research aims to describe how the system has been applied, particularly in supporting electronic journal searches. A descriptive qualitative approach was used, with data collected through observations, interviews, and document analysis. Six informants participated in the study, including the head librarian, librarians, lecturers, and students. The findings show that the AI chatbot is capable of interpreting user search intent through Natural Language Processing (NLP), processing queries intelligently, and providing fast, relevant, and detailed results from 18 electronic journal databases subscribed to by the USU Library. Users reported substantial time savings and greater convenience in obtaining accurate academic references. Overall, the introduction of AI has contributed positively to the quality of information services, although challenges remain in areas such as infrastructure, staff training, and digital collection development. The study concludes that AI-based information retrieval represents a strategic innovation for enhancing library services, enabling them to become more adaptive, efficient, and responsive in the digital era.

Keywords: Artificial intelligence; Chatbot; natural language processing; Information retrieval system

1. INTRODUCTION

The development of libraries in the digital era has transformed the way they manage and present information to users. The growing demand for information encourages libraries to provide relevant and easily accessible information resources. The accuracy of information obtained by students significantly improves the efficiency of their information-seeking process. Librarians consistently strive to ensure user comfort in accessing information and to maintain the quality of library services. This is in line with the findings of Lu et al. (2024), who

stated that digital transformation in academic library management not only requires adaptation to technology-based service systems but also involves fundamental changes in collection management strategies, user services, and librarian competencies. In this context, libraries are required to integrate information technology into all operational aspects—from the acquisition and management of digital resources to the delivery of online reference services. Lu et al. (2024) further emphasize that the success of this digital transformation has a significant impact on user satisfaction, the effectiveness of information retrieval, and students' perceptions of the relevance and quality of library services in the digital era.

The University of North Sumatra (USU) Library provides information literacy services to support the academic activities of the university community. These services offer electronic access for students and lecturers to a variety of resources, including e-journals, e-books, and repositories, through the library's official website. Among these resources, e-journals are the primary focus of this study due to their crucial role in supporting teaching, learning, and research activities. By providing access to high-quality, up-to-date, and reliable academic reference sources, the USU Library ensures that the entire academic community can obtain relevant information that supports the advancement of knowledge across various disciplines. These services also emphasize ease of access and the efficiency of information retrieval, enabling students and lecturers to make optimal use of the library's resources.

Based on observations conducted in December 2024 in the Information Literacy Room of the University of North Sumatra (USU) Library, the researcher observed ten students engaged in searching for electronic journals to complete their academic assignments. The findings revealed that, in the absence of an AI-based chatbot, students were required to access each subscribed database separately and manually input search keywords into individual search interfaces. Searches conducted within a single database frequently yielded hundreds or even thousands of results, many of which were only partially relevant or unrelated to the students' information needs. This situation resulted in information overload, compelling students to invest a substantial amount of time and cognitive effort in filtering, evaluating, and selecting appropriate journal articles to support their academic work.

Theoretically, the AI-based information retrieval system approach is closely related to the concept of Learned Sparse Retrieval (LSR) through the SPLADE model introduced by Thibault Formal, Benjamin Piwowarski, and Stéphane Clinchant in 2021. This model positions documents based on their probability of relevance to a user's query rather than mere keyword matching. It has also become the foundation for many modern search systems supported by artificial intelligence (AI). In this context, AI is utilized to estimate the extent to which a document satisfies a user's specific information needs through content and context analysis. The development of AI-based retrieval systems integrates Natural Language Processing (NLP) and machine learning, encompassing several key processes: indexing, query understanding and processing, intelligent matching and ranking, and system performance evaluation.

Within the context of the University of North Sumatra (USU) Library, this theory is relevant as it illustrates how the application of AI technology can enhance the effectiveness of information retrieval among users. An AI-driven system enables more accurate and efficient e-journal searches by understanding user context and information needs, thereby overcoming the challenges of traditional manual searches that often yield excessive and irrelevant results. Consequently, the LSR theory provides a conceptual foundation for analyzing the implementation of AI-based information retrieval systems in the USU Library,

particularly in improving the accessibility, accuracy, and efficiency of information search services for students.

Several previous studies have examined the implementation of AI-based information retrieval systems in library environments and information search systems. Sari et al. (2023), in their study "Optimizing Information Retrieval with Artificial Intelligence Technology in Libraries", reported that the application of artificial intelligence (AI) in the STIPRAM Library positively influenced the ease and effectiveness of information retrieval. The study indicated that AI could assist both users and librarians in conducting research and performing daily tasks. However, the study remained largely descriptive and did not provide an in-depth examination of user experiences or the challenges associated with AI implementation in university library settings. Meanwhile, Mutiara Rahmadani et al. (2023), in their study "AI Technology in Improving the Accuracy of Health Information Search Systems", highlighted the use of machine learning to enhance the efficiency of health information searches. Although the results demonstrated improved search speed and accuracy, the study was focused on the health domain, rather than on library contexts or user behavior in academic information retrieval.

From these studies, it can be concluded that research on AI implementation in information retrieval systems has been largely limited to technical aspects and system efficiency, while user experience, satisfaction, and the relevance of AI application in the context of Indonesian university libraries have received little attention. Therefore, this study aims to address this research gap by analyzing the implementation of AI-based information retrieval systems at the University of North Sumatra (USU) Library, particularly in understanding user experiences, system effectiveness, and the challenges of AI integration in enhancing the accessibility and accuracy of library information services.

According to Idhris and Peter (2024), the implementation of AI-based chatbots in library operations shows great potential for improving service efficiency and the quality of information retrieval. They stated that the use of chatbots allows for automated, real-time responses, which results in increased user engagement and reduced librarian workload.

This research is important because developments in information technology, particularly artificial intelligence (AI), have changed the way users access and find informatio. The urgency of this research is also based on the increasing expectations of university users for intuitive, intelligent, and personalized information services. By implementing AI technology, libraries can improve service quality, speed up the search process, and reduce user frustration due to irrelevant search results.

The purpose of this study is to examine the implementation of AI-based information retrieval systems at the University of North Sumatra Library, explore user experiences and satisfaction levels in utilizing AI chatbots for information searching, and evaluate the effectiveness and challenges of AI integration in enhancing the accessibility and accuracy of library information services. Based on the above explanation, the findings of this study are expected to contribute to the advancement of the USU Library. The implementation and development of AI systems in the library will facilitate students in retrieving more accurate and relevant information according to the specific needs of library users.

This study is expected not only to contribute to the development of the University of North Sumatra Library but also to provide broader implications for global readers. By understanding how academic libraries in developing countries adopt and utilize AI technologies, this research can serve as a reference for libraries worldwide in developing

more adaptive, user-oriented, and technology-driven information services. This aligns with the perspective of Islam et al. (2025), who emphasize that the application of artificial intelligence in academic libraries has become a key driver of digital transformation, particularly in improving the efficiency of information retrieval and enriching global user experiences. Furthermore, Emin (2025) highlights that the integration of AI technologies not only affects service systems but also demands a shift in librarians' work culture and service design toward a more proactive response to users' needs in the digital era.

2. METHODS

This study employed a qualitative descriptive approach aimed at describing field findings without manipulating any variables. The research focused on understanding phenomena as they occurred in their natural setting and on examining how processes unfolded in practice. The qualitative descriptive method was selected to explore emerging and complex phenomena, particularly those related to the implementation of artificial intelligence technology within the library environment. The study was conducted in the Information Literacy Room of the University of North Sumatra Library during the research period.

The researchers collected data through observation, interviews, and documentation. Observation involved directly monitoring user activities during the process of searching for electronic journals using an AI-based chatbot within the information literacy setting. The researchers conducted in-depth interviews with informants selected through a purposive sampling technique, whereby participants were chosen based on predefined criteria aligned with the research objectives. The informant criteria included: (1) library policymakers, (2) information literacy service managers, and (3) AI chatbot users, comprising lecturers and students. Based on these criteria, the researchers selected the head of the library as the policymaker, one librarian as the service manager, and three participants as chatbot users. Documentation was carried out digitally in the form of screenshots of electronic journal search activities and audio recordings of interviews with the informants.

Several documentation materials could not be presented due to institutional privacy policies. The researchers analyzed the data interactively through three main stages: data reduction, data presentation, and conclusion drawing with verification. Data reduction involved selecting and focusing on information relevant to the research objectives. Data presentation was organized in descriptive narrative form to facilitate the identification of patterns and relationships among data categories. The researchers drew conclusions based on interpretations of verified findings obtained through triangulation. To ensure data trustworthiness, the study applied data source triangulation by collecting information from multiple sources and validating data obtained from one source through comparison with data from other sources. This process enhanced the validity and reliability of the research findings.

The study identified 18 databases subscribed to by the University of North Sumatra Library in the form of electronic journals, which were accessible through the website library.usu.ac.id to support the academic community of the University of North Sumatra.

Table 1. The subscribed databases

No	Disciplines	Databases
1	Multidisiplin	1. Springer Link 2. Science Direct 3. Sage Journals 4. Proquest 5. EBSCO 6. GALE 7. JSTOR 8. Sage Research Methods
2	Health	1. Clinicalkey
3	Science and Technology	1. IEEE Xplore 2. AIP 3. IOP Publishing 4. APS Physics 5. Taylor & Francis
4	Social Sciences and Humanities	1. Taylor & Francis 2. Emerald Insight 3. Westlaw 4. China National Knowledge Infrastructure (CNKI)

3. RESULTS AND DISCUSSION

Implementation of an AI-Based Information Retrieval System

In the context of ongoing digital transformation, libraries have undergone a significant shift from functioning merely as repositories and lending spaces for physical collections to becoming dynamic, technology-driven information centers that actively respond to evolving user needs. One prominent form of innovation increasingly adopted in contemporary library services is the integration of artificial intelligence (AI) into library systems and information services.

At the University of North Sumatra (USU) Library, the implementation of AI was applied within information literacy services, specifically to support information retrieval through electronic journal systems. In the domain of information retrieval, AI enhances search accuracy by employing natural language processing (NLP), content classification, and relevance-based ranking mechanisms, enabling more precise retrieval outcomes beyond simple keyword matching. Furthermore, AI was implemented in the form of a chatbot designed to provide automated, real-time responses to user queries. This system supplements conventional reference services, which are often constrained by librarian availability, time, and workload.

In addition, the incorporation of machine learning capabilities enables the AI system to analyze user interaction patterns and information-seeking behavior. Through this adaptive learning process, the system can generate personalized recommendations for journals, articles, or other scholarly resources aligned with users' academic interests and information needs. Collectively, these AI-driven functionalities contribute to a more efficient, responsive, and user-centered information literacy service within the library environment.

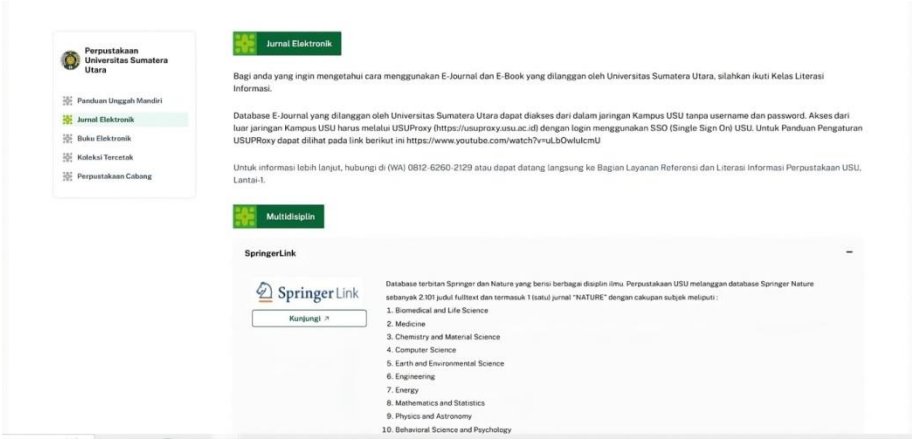

Figure 1. The 18 subscribed databases by USU Library

The image illustrates the library.usu.ac.id website, specifically the e-journal section that presents the list of electronic databases subscribed to and accessed by the University of North Sumatra (USU) Library. Among the databases displayed is Springer Nature, one of the world's leading publishers of scientific journals and e-books. This section appears under the "List of E-Journals Subscribed to and Accessed by the USU Library" menu, with particular emphasis on the multidisciplinary category. As shown, the Springer Nature database provides access to more than 3,100 journal titles and over 7,000 e-books available to the entire USU academic community. These resources span a wide range of disciplinary fields, including biomedical and life sciences, medicine, chemistry and materials science, computer science, earth and environmental sciences, engineering, physics, mathematics and statistics, as well as the humanities, social sciences and law, and business and management.

Based on the database interface presented above, the librarian explained that the 18 subscribed databases serve as the primary data sources in the development of the AI chatbot. These databases were integrated into the chatbot system through terminal-based coding processes structured across three main stages: indexing, query processing, and result ranking. This design framework enables the AI chatbot to retrieve and organize scholarly information efficiently and to deliver relevant search results aligned with users' information needs.

The AI chatbot implemented by the USU library is unique in its functionality. The user's search process begins with selecting a basic science related to the topic they are searching for, such as economics, science, social studies, health, law, and so on. After selecting the basic science, the system directs them to the search field. In the search field, users can enter keywords they are searching for, and they can even use questions or statements. For example, if a query asks, "I need the latest journal on machine learning in the health sector," the chatbot uses Natural Language Processing (NLP) techniques to understand the user's intent. The system identifies important entities, such as the main topic ("machine learning") and the application domain ("health sector"). After understanding the user's intent, the AI chatbot converts the input into a query that can be processed by the journal search system. The AI then accesses the electronic journal databases subscribed to by the USU library, such as IEEE, Springer, ScienceDirect, EBSCOHost, Prequest, and others. The system ranks the results based on their relevance to the user's query. Search results are presented in an easy-to-understand summary and journal recommendations relevant to the search topic. For example: "Here are 3 recent journals on machine learning in healthcare, including one from the 2024 IEEE Access journals that discusses heart disease detection using CNNs". A paper by

Rygl et al. (2017) showed that semantic vector encoding and similarity search methods run through search engines enable more efficient and accurate indexing, query processing, and semantic ranking, by leveraging the advantages of full-text search engines for optimal retrieval performance and quality.

Furthermore, users can continue by giving further commands to the AI without having to repeat the same topic. For example, the user's basic search is to find journals in the health field, and the results provided by the AI discuss health and even provide specific recommendations for heart health. If the search doesn't meet their needs, the user can direct the system back to a more specific health field, for example, skin health, public health, eye health, and so on. The AI will respond to the user's search topic. Overall, it can be concluded that AI is very helpful for users in the information search process. AI works according to the requests and commands given by the user. This allows users to manage their available time well.

Kim et al. (2024) also suggest that a conversational search system based on large language models enables multi-step interactions: users can ask follow-up queries without repeating the initial topic, making search more natural and efficient. Through an analysis of 2,061 real-world interactions, they also describe various patterns of user motivations and strategies in providing follow-up commands, as well as how these patterns indicate user satisfaction with the system.

Technically, this system utilizes Natural Language Processing (NLP) technology to recognize and interpret natural language used by users. This allows users to ask questions such as "what are the references on renewable energy in Indonesia?" and the system will display results based on context, not just literal matches to keywords. Furthermore, the system utilizes machine learning to learn user search patterns and improve search accuracy over time. The automated recommendation feature in the AI-based information retrieval system has significantly contributed to the efficiency of library services. By helping users find information quickly, relevantly, and even beyond what they are looking for, this system not only improves technical effectiveness but also strengthens the library's role as a digital knowledge center that is proactive and adaptive to the needs of the times.

These findings are consistent with international studies by Anand et al. (2023), which demonstrate that NLP is capable of understanding user intent contextually; Mitra and Craswell (2017), who highlight that machine learning integration enhances search accuracy; and Zhu et al. (2024), who emphasize that AI-based recommendation systems play a crucial role in improving the efficiency of digital information services.

Natural Language Processing (NLP) is a branch of AI that enables computers to understand, interpret, and produce human language. In the context of libraries, its operation involves several main stages: Tokenization: The user-typed sentence is broken down into units of words or phrases for individual analysis. Part-of-Speech Tagging: The system recognizes the function of each word (noun, verb, adjective) to understand the sentence structure. Named Entity Recognition (NER): Identifies important entities in the text, such as author names, topics, years, or locations. Stemming and Lemmatization: converts words to their base form so that searches are not limited to a particular word form. For example, “developing,” “development,” and “developing” are thought to originate from the root word “develop.” Semantic Matching: The system compares the meaning of the user’s query with existing documents to find contextual, not just literal, matches. Ranking and Relevance:

Documents or search results are scored and sorted based on the probability of relevance to the user's query, according to the principles of probabilistic models (Subchan 2024).

Thus, the use of AI chatbots, particularly NLP, in library systems opens up significant opportunities to improve the quality of information services. With NLP, searches no longer rely on rigid keywords, but rather on a deeper understanding of meaning and context. This helps users, especially students and researchers, find more relevant and accurate information in a more natural and efficient manner. However, this implementation requires sound data, competent human resources, and systematic evaluation for AI technology to truly become a tool that supports information literacy in the academic environment of the University of North Sumatra.

Effectiveness and Efficiency of AI Search

According to Gana, Salau, Uno, Tauheed, and Gana (2025), most respondents expressed a positive perception toward the use of chatbots in academic library services. They believe that the implementation of chatbots can enhance both the efficiency and effectiveness of information services, particularly in responding to users' needs quickly and consistently. Chatbots are considered capable of assisting librarians in managing large volumes of information requests without compromising service quality. Moreover, this technology is viewed as expanding the reach of library services, as users can access information assistance anytime—even beyond regular operating hours. Thus, the integration of chatbots represents a strategic step toward the modernization of library services while strengthening users' overall experience in searching for and obtaining information efficiently.

Interviews with students, lecturers, and librarians indicate that AI systems in the library significantly accelerate literature searches. Intelligent search features and automated recommendations enhance the accuracy and relevance of results to users' research topics. Moreover, these systems facilitate the efficient exploration of new information sources.One of the students named Bernadetta br Situmorang from the Faculty of Economics, also felt the positive impact received after using AI for information search. She said:

> *"I just learned that the USU library is using an AI-based search system, specifically for journals. Using it, the search process was straightforward. It turns out that using AI saves me the hassle of searching through each of the 18 databases in the USU library. I find AI to be beneficial in terms of time, and the results are tailored to students' needs, especially in their final semesters as a reference for writing their final papers."*

Students like Bernadetta have experienced significant benefits from the use of AI chatbots in library information retrieval, particularly in terms of time efficiency and ease of access. This aligns with the findings of Sitanggang et al. (2023), who emphasized that responsive chatbots, available 24 hours a day, enhance user satisfaction by providing convenient access to information at any time. Similarly, Nurholis et al. (2025) found that ease of use, response speed, and the relevance of search results are the main factors influencing user satisfaction with AI-based services. In addition, Ali (2024) highlighted that the implementation of AI chatbots in modern libraries plays a crucial role in accelerating information retrieval processes, strengthening reference services, and supporting students' research and learning activities.

Meanwhile, lecturers and researchers highlighted the time efficiency and quality of search results. They noted that the AI system was able to identify relevant academic sources more quickly than previously used manual search methods. Some lecturers even stated that they were able to discover new references they had never accessed before because the

system recommended them based on topics, they frequently research. For example, Mr. Chandra Sidauruk, a lecturer in the Faculty of Economics, stated:

> *"I find AI-based retrieval systems to be very helpful in streamlining scientific information searches. As a lecturer, I often search for journal references for lectures or research. With the help of AI, such as a journal search chatbot, I simply type in a topic or even a question in natural language, and the system immediately provides relevant, curated results. This saves me up to 60–70% of my time compared to conventional methods. I believe users can use this free time to analyze while working on assignments."*

From the lecturer's response, it can be concluded that AI speeds up information retrieval. AI even has a positive impact that users can experience when using it as an information retrieval system

This statement is reinforced by the findings of Fouad Trad et al. (2020), who explained that the implementation of Large Language Models (LLMs) in systematic reviews can reduce article screening time by up to 95% without compromising result accuracy. Similarly, José de la Torre-López, Aurora Ramírez, and José Raúl Romero (2023) emphasized that artificial intelligence plays a crucial role in accelerating the identification of relevant literature through the automation of data analysis and classification processes. In addition, the research conducted by Chubb, Cowling, and Reedman (2022) also demonstrates that the use of AI helps researchers save time across nearly all stages of research, particularly in literature search and management. In line with this, the study by Abogunrin et al. (2025) shows that the application of AI in systematic literature reviews can reduce screening time by more than 50%, with abstract screening taking 5 to 6 times less time compared to manual methods. Collectively, these expert perspectives reinforce the findings from the interview, indicating that the use of AI in information retrieval systems not only accelerates literature searches but also enhances efficiency, accuracy, and overall academic productivity.

User Experience and Satisfaction

Users utilize the information searched by AI chatbots by utilizing the search results as primary references in their academic activities, such as writing papers, final assignments, theses, or scientific research. After the AI chatbot displays search results based on the keywords or questions provided, users will read and assess the extent to which the information aligns with their needs. Typically, users will look at key elements of the displayed results, such as the article title, abstract, author name, year of publication, and access link. From this information, users can determine relevance to their search topic. If they find it relevant, they will save or download the document for further study.

For example, one of the students, named Bernadetta Br Situmorang from the Faculty of Economics, gave a positive argument, that:

> *"I wanted to find references for my undergraduate thesis regarding 'the impact of digital literacy on students'. The search results provided included articles discussing the influence of digital literacy on student learning behavior, critical thinking skills, and adaptation of technology use in the academic process. This system was even able to maintain the search context when I asked follow-up questions. After the initial search, I typed 'how is it implemented in a campus environment?', and the AI was able to respond quickly and the information provided was still relevant to the previous topic without me having to repeat the initial context."*

This shows that the system has a fairly good natural language processing capability in understanding the relationship between topics in a series of searches conducted by the user.

These findings are consistent with the study by Cakir, Saleemi, and Zimmermann (2021), which explains that neural ranking models are capable of capturing semantic relationships between topics through the learning of raw text representations, thereby producing a more accurate and contextual information retrieval system. Furthermore, Hirst et al. (2021) demonstrate that Transformer-based models, such as BERT, enable information retrieval (IR) systems to comprehend queries in their full contextual meaning. These findings are also supported by Thakur et al. (2021), who conducted the BEIR benchmark and confirmed the effectiveness of NLP in more accurately connecting concepts across documents.

As conveyed by Bernadetta br Situmorang, as an AI chatbot user, she stated that:

> *"After the AI displays search results, I analyze the relevance of the information provided by the AI. If it aligns with my needs, I download the file and use it as a reference for my academic writing. I don't even stop there; sometimes I also check or compare the sources suggested by the AI chatbot with trusted sources like Scopus, Sinta, and other journals. But so far, the results provided by the AI align with my needs. It's safe to say that AI can be prioritized for information retrieval."*

Users also frequently use search results as a basis for seeking further information. This means that AI chatbot results serve as a starting point for broader literature exploration. Thus, AI chatbots play a crucial role in simplifying, accelerating, and enriching the process of searching and utilizing information in academic settings, particularly at the University of North Sumatra (USU) library.

According to Saleh Afroogh et al. (2024), users' trust in artificial intelligence systems is strongly influenced by the level of transparency, accuracy, and the way the system presents information. This is clearly reflected in the behavior of academics who use AI chatbots for literature searches, they do not immediately accept all the search results but first assess bibliographic aspects such as the title, author, year, and abstract to ensure relevance. This view aligns with Thiebes, Lins, and Sunyaev (2021), who emphasize that trust in AI depends on the system's transparency, fairness, and explainability. Similarly, Garg, Ahmad, and Madsen (2024) found that although AI tools such as ChatGPT and Bard can accelerate the literature search process, academic users still need to verify the results using traditional scholarly databases such as Scopus and Web of Science to ensure accuracy and reliability. Supporting this, Martín-Moncunill and Martínez (2025), in their study at Camilo José Cela University, revealed that most students actively verify AI-generated results by comparing them with other academic sources to ensure alignment with established scholarly standards. Thus, these findings collectively highlight that the use of AI in academic contexts is not merely aimed at obtaining information quickly, but also reflects users' critical, evaluative, and responsible attitudes in ensuring the validity and credibility of the information they utilize.

Ehrenpreis and DeLooper (2025) emphasize that users' trust in the search results provided by chatbots is strongly influenced by the system's level of transparency. Chatbots that clearly display information sources, such as including metadata, direct links to articles, or the originating database, encourage users to have greater confidence in the validity of the information they receive. This practice not only enhances trust but also strengthens users' habits of independently verifying the references generated by artificial intelligence. In addition, the authors highlight the importance of user interface design that enables users to navigate the original sources without technical barriers. Therefore, the principles of transparency and auditability are key factors in ensuring that chatbot systems in libraries can be utilized safely, ethically, and responsibly by the academic community.

Challenges and Improvement Need

Although the implementation of an artificial intelligence (AI)-based information retrieval system at the University of North Sumatra (USU) Library has brought significant progress in terms of efficiency, relevance, and search speed, several challenges still need to be addressed to ensure its optimal and sustainable implementation. One of the main challenges lies in the readiness of digital infrastructure. Based on observations, the AI system at the USU Library continues to face limitations in internet speed, server capacity for large-scale data processing, and the ability to integrate with various external databases subscribed to by the university. These limitations often result in delays in displaying search results or incomplete retrieval of relevant sources. Akinola (2024) also explains that deficiencies in technical infrastructure lead to slow system response times and reduced accuracy in information retrieval. This situation is similarly observed at USU, indicating that strengthening network capacity, upgrading hardware, and enhancing system interoperability are strategic steps that must be prioritized to ensure that AI operates efficiently and reliably in supporting academic activities.

Another critical aspect concerns ethical and data privacy issues. AI systems require access to user data to generate relevant recommendations; however, without transparent management and clear privacy policies, this may lead to concerns over potential data misuse. Aly Ibrahim (2025) emphasizes that AI implementation in libraries must be grounded in the principles of privacy and patron confidentiality, supported by strict institutional policies, informed user consent, and robust data encryption mechanisms.

A further challenge relates to AI literacy and librarian competence. Many librarians at USU are still adapting to AI-based tools and have yet to fully understand how algorithms determine relevance or correct retrieval errors. According to Kalbande, Prasad, and Bansode (2024), librarian AI literacy is a key factor determining the success of technology integration. Therefore, continuous training is essential to enable librarians to serve effectively as facilitators in AI-driven library services.

In addition, the lack of systematic evaluation and continuous updates remains an obstacle to maintaining system effectiveness. Algorithm and database updates are often conducted reactively rather than through scheduled evaluations. Malik (2025) and the American Library Association (2023) highlight that the implementation of continuous feedback loops and regular audits is crucial to maintaining system accuracy and reliability.

Overall, the implementation of AI at the USU Library faces interrelated challenges—limited infrastructure, ethical and privacy issues, librarian competence, and evaluation mechanisms. Strengthening technical capacity, improving privacy governance, and enhancing librarian competencies must therefore be prioritized to ensure that AI truly serves as a strategic tool in improving the quality of academic information services at the University of North Sumatra.

4. CONCLUSION

The implementation of an artificial intelligence (AI)–based information retrieval system at the University of North Sumatra (USU) Library has demonstrably enhanced the efficiency of information searching, improved the accuracy of retrieval outcomes, and increased the relevance of recommended academic resources. By integrating technologies such as natural language processing (NLP) and machine learning, the system enables students and lecturers

to access electronic journals in a faster, more contextualized, and increasingly personalized manner. This technological advancement represents a substantive improvement over conventional keyword-based search mechanisms.

The AI chatbot implemented at the USU Library exhibits the capacity to interpret user queries contextually and to generate search results that reflect underlying informational intent rather than relying solely on literal keyword matching. As a result, the system streamlines access to scholarly content drawn from 18 subscribed databases, significantly reducing the time and cognitive effort required for users to identify relevant academic materials. Findings from observations and in-depth interviews indicate that both students and lecturers derive considerable academic benefits from the system, particularly in activities related to scientific writing, research, and learning. Moreover, the chatbot demonstrates effectiveness in maintaining contextual continuity across search interactions, thereby supporting more coherent and iterative information-seeking processes.

Despite these positive outcomes, several challenges remain, including the need for strengthened technological infrastructure, enhanced user training, and broader digitization of library collections to maximize system performance and accessibility. Nevertheless, the integration of AI within the USU Library constitutes a strategic milestone in its digital transformation agenda. By leveraging intelligent information systems, the library reinforces its role as an inclusive, adaptive, and technology-driven knowledge center capable of meeting contemporary academic demands.

AUTHORS' CONTRIBUTIONS

Halbert Alfonsus Sihaloho: Ideas; formulation or evolution of overarching research goals and aims. **Fransiska Timoria Samosir:** Ideas; formulation or evolution of overarching research goals and aims. **Rahmat Alifin Valentino:** Writing oiginal draft preparation.

CONFLICT OF INTERESTS

We state that there are no known conflicts of interest linked with this publication, and that there has been no significant financial assistance for this work that could have influenced its outcome.

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