

Artificial Intelligence in Library Studies: A Textual Analysis

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ABSTRACT

Artificial intelligence has emerged as a promising technology in the post-pandemic era, significantly impacting the library ecosystem and the direction of library and information science studies. This study aims to map AI-related research in libraries to identify opportunities and discuss future directions. Using textual analysis of data from Scopus, the study analyzed article titles with the burst detection algorithm and abstracts with scattertext and lemmatization. Six burst words were detected out of twelve frequently appearing in titles. Scattertext results showed a comparison between the service side (red) and the development side (blue) in libraries. Research increasingly focuses on AI utilization for library services and natural language processing (NLP) to enhance services. On the development side, AI involves product creation and encompasses AI literacy frameworks, policies, and their impact on libraries. AI affects studies in libraries by changing application methods, such as machine learning and NLP. Future research will become more diverse, considering the unique characteristics of each library.

KEYWORDS

Artificial intelligence; Library; Trend; Textual analysis; Library studies.

Introduction

The hot topic in the world of technology that has been developing lately, namely artificial intelligence (AI), has spread to all aspects of life such as business, education, and including libraries. AI has brought about a tremendous shift in post-pandemic life, where in difficult times, libraries are required to make various innovations to meet challenges. As libraries adapt to this rapid advancement, the integration of AI becomes essential, not only to enhance existing services but also to redefine the skill set required for library professionals. Such changes present challenges to the library world to transform the existing body of knowledge as well as the development of competencies and efforts (Cox, Pinfield, and Rutter 2019).

The development of technology is not something new in the library environment, including AI. Technologies like this will become a crucial skill in the future workplace (Finley 2019), reflecting the need for librarians to understand this more deeply. AI itself becomes a large umbrella that includes many things, such as chatbots, text data mining, and document classifiers, which can change the face of the library (Izquierdo 2022). Skills like this will complement librarians' skills in providing information to users, providing new opportunities and perspectives in the landscape of research, education, services, and studies in the near and distant future.

This study aims to map studies related to AI and libraries from relevant literature to identify opportunities and discuss the direction of future studies, and this is a contribution that begins a path of research without claiming to be exhaustively addressed. Analysis will be conducted on the titles and abstracts of articles, as well as further examination of the articles' content. This study also attempts to provide an overview of opportunities using alternative textual analysis methods other than keyword analysis.

Literature Review

AI is not something new, considering its long development, but it currently feels like it is reaching its peak utilization (Cox, Pinfield, and Rutter 2019). The definition of AI itself has many versions, but simply put, this technology has the ability to mimic what humans do every day (Wheatley and Hervieux 2020; Cox and Mazumdar 2024). The emergence of AI has also popularized other terms, such as natural language processing (NLP) and machine learning (ML). Halper (2017) argues that NLP and ML are subfields of AI, although there is overlap in the use of the terms. As users begin to adapt to new technology, libraries will adopt its use (Wheatley and Hervieux 2020), which illustrates that libraries themselves are closely tied to technological changes. Changes such as the use of chatbots, changes in search patterns, and experiments with text and data mining are examples of the impact felt by libraries (Cox and Mazumdar 2024).

Several studies have been conducted to identify trends and opportunities for the use of AI in libraries. Borgohain, Bhardwaj, and Verma (2024) and Vasishta, Dhingra, and Vasishta (2024) attempted to examine the utilization of AI in libraries using data obtained through Scopus, while Nugroho, Anna, and Ismail (2023) tried to focus on a more specific aspect, which is library repositories during the pandemic using the same data source as the two previous studies. Oyelude (2021) took a different approach by conducting a study using data from blogs and wikis. The research conducted was limited to the use of VOSviewer (Vasishta, Dhingra, and Vasishta 2024) and Bib-

lioshiny (Nugroho, Anna, and Ismail 2023; Borgohain, Bhardwaj, and Verma 2024) for keyword analysis. Meanwhile, there is an opportunity to further analyze article titles and abstracts, instead of just using keywords.

General text analysis is commonly used to interpret textual data into meaningful data, for example, analyzing the title and abstract of an article. This analysis can be done in various ways, such as using topic modeling, burst detection, and scattertext. Burst detection can help to identify a sharp increase in the frequency of a word, indicating a burst of activity (Kleinberg 2002). Meanwhile, scattertext helps to provide a visual representation of word variation between categories in a set of textual data (Kessler 2017). These methods provide an overview for conducting alternative analysis on a set of texts.

Methodology

The data used for analysis was obtained from Scopus abstract databases and citations on July 4, 2024, using the search keywords artificial intelligence, information science, and libraries narrowed down to the time range of 2015 to 2024. Search narrowing was also done by specifying that only journal articles and proceedings would be analyzed, as well as articles marked under the social subject. Furthermore, the selection of relevant sources was also done manually, resulting in a total of 285 documents. The advanced query used in this study can be accessed in the research data available in the Repositori Ilmiah Nasional¹.

Initial analysis was conducted on the article titles using the burst detection method introduced by Kleinberg (2002). This algorithm helps track bursts of words in a textual dataset, in this case, article titles. The study focused on the 12 most frequently occurring words. Further analysis was conducted using scattertext introduced by Kessler (2017). Through scattertext, the analysis was done by comparing the differences between two groups of words that frequently appear with different topics, with a minimum term count set at 3 times in this study. Cleaning was also done on the abstracts by applying lemmatization and eliminating copyright statements and punctuation. The entire process was conducted using the web-app Coconut Libtool (Santosa et al. 2024).

Result

Using the predetermined parameters, the 12 most frequently appearing words over the past 10 years are academic, service, chatgpt, research, technology, application, analysis, base, science, smart, university, and development. The word “academic” is the most frequently used in titles with 36 appearances, followed by “service” with 32, and “chatgpt” with 29. The lowest 3 are “smart,” “university,” and “development” with values of 18, 17, and 16 respectively. In terms of the year of appearance, the word “chatgpt” only appeared in 2023 with a total of 18 appearances. On the side of words that experienced bursts at certain time intervals, out of the 12 specified words, only 6 words were detected (Figure 1). These six words experienced a “burst” at the same time interval, from 2023 (point 8) to 2024 (point 9). Chatgpt has the highest score (9.591) com-

¹ <https://hdl.handle.net/20.500.12690/RIN/SQNP3G>.

pared to the others with a difference of more than 5 with the word “application” which has a value of 4.43. Meanwhile, in terms of appearances, the word with the lowest value is “development” which only has a difference of 2 in appearances in 2023 and 2024. On the other hand, the word “service” ranks in the top 2 with a total of 26 appearances in 2023 and a total of 32 at the end of the year range in the data.

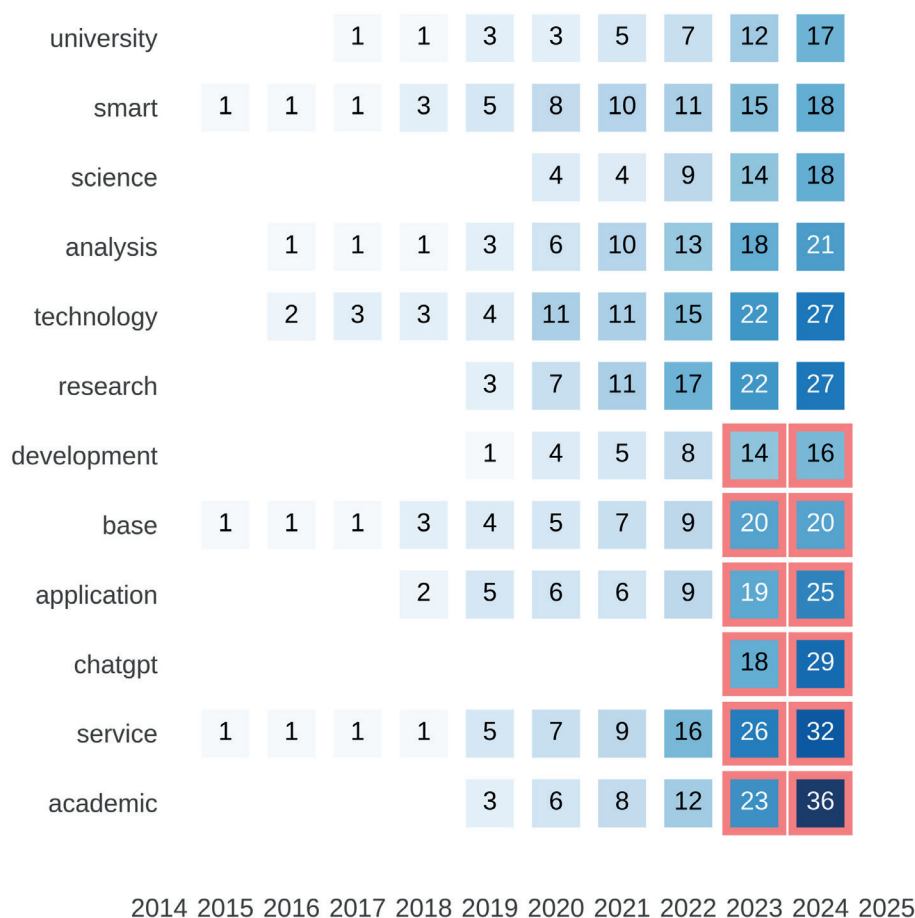


Figure 1. Words detected as burst in the title of the article.

Further analysis was conducted on the abstract using scattertext by dividing it into 2 parts. Term 1 (focus on services) consists of documents that have the word “service” in their abstracts, while Term 2 (focus on development) is divided by the words “application” and “development” (Figure 2). In Term 1, there are 128 documents with a total of 20,569 words, represented by words such as robot, reference, virtual, chatbot, and pandemic. Term 2 has more documents, totaling 24,933 words in 149 documents, and is reflected by words such as graph, algorithm, machine, model, and framework.

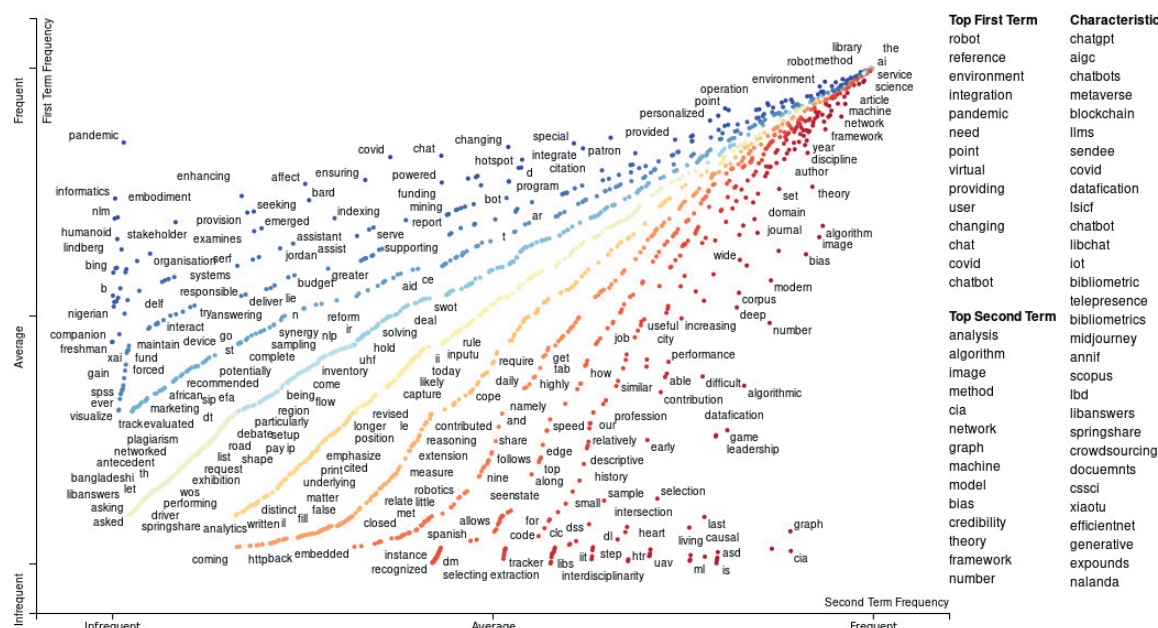


Figure 2. Comparison of words in the abstract of documents Term 1 and Term 2.

Discussion

Studies on AI in relation to library services have been widely conducted in recent years. The increase in this topic has been more rapid compared to previous years, especially after OpenAI released ChatGPT towards the end of 2022. Meanwhile, studies on library development such as librarian capabilities, strategies, policies, infrastructure, and retrieval are starting to be discussed more frequently, especially on how to apply them in everyday life in the library.

Library services

The pandemic has brought many changes to the needs of users and has led to many innovations to adapt to life after the pandemic. Innovations are made to respond to uncertain situations so that services can continue to operate amidst limited access, such as the difficulty of physically attending the library. The use of technology such as chatbots in reference services can provide general assistance with the resources and information needed (Li and Coates 2024; Lappalainen and Narayanan 2023). This situation brings libraries into a positive paradigm in their operations, especially academic libraries (Dube and Jacobs 2023).

Okunlaya, Syed Abdullah, and Alias (2022) saw AI in two dimensions, namely digital transformation technology and changes in value creation. The first dimension explains various aspects including the use of robots. For example, a study conducted by Yao, Zhang, and Chen (2015) on how a smart robot named Xiaotu is identified as a promising new reference service. The use of robotics along with AI is considered to provide faster integrated services (De Sarkar 2023). Robots themselves come in various forms and uses, from traditional forms to those resembling humans.

Humanoids are also mentioned on several occasions (Tella and Ajani 2022; De Sarkar 2023). In fact, Tella and Ajani (2022) suggested that, although still in the development process, libraries need to develop strategic plans for such technologies.

In the second dimension, Okunlaya, Syed Abdullah, and Alias (2022) mentioned that besides robotics, there are algorithms and NLP that can create value for library services. For example, Wang (2022) analyzed transcripts of reference service messages using various algorithms. This study provides an overview of the use of NLP as a method for examining textual data in libraries, considering the close relationship between libraries and this type of data. NLP can also be used by libraries to provide reference services through chatbots. Several studies have examined this technology, such as ChatGPT (Lund, Khan, and Yuvaraj 2024), Bing Chat (Adetayo 2023), Ivy Chatbot (Ehrenpreis and DeLooper 2022), Google Bard (Adetayo and Oyeniyi 2023), or developing their own chatbot like Aisha (Lappalainen and Narayanan 2023).

By paying attention to the uniqueness and local content, research related to AI will also be more varied. Although Large Language Models (LLMs) are commonly used for conversational tasks, they can also be utilized for other purposes, as demonstrated by Carroll and Borycz (2024), who used LLMs and generative AI for information literacy instruction. This shows that libraries can also leverage their own data and resources for more specific matters, especially when their local content is available in the local language. With the numerous implementations of AI in available library services, a new market is created, leading to the emergence of companies that offer their services with varying features and prices. Research on the effectiveness of similar applications also presents an opportunity for future discussions. Additionally, the utilization of free resources as an option can be considered by librarians, as well as how libraries can serve as examples to pave the way for other libraries to implement similar initiatives. This can be an important topic for providing equitable access and accelerating the development of libraries.

The use of AI in library services provides a variety of research objects, such as how to use AI to provide direct services, especially when librarians are not present, so that patrons can be served 24 hours a day using chatbots. Other studies attempt to compare AI as a tool to provide optimal services (Khan et al. 2023). The development of library services with AI also needs to consider the potential impact on the role of librarians and existing workflows (Adetayo 2023), indicating that future research will focus on this. Lund, Khan, and Yuvaraj (2024) also noted the need to ensure quality control and validation, as well as increasing awareness of AI.

Development of Libraries and Librarians

The advancement of technology and the increasing use of AI in various sectors have had an impact on the way of life in society, including in the library environment. This has created pressure for libraries to develop and conduct research to address the current gaps in AI and ML (Vasishta, Dhingra, and Vasishta 2024). Considering the uniqueness of each library, the development of libraries using technology has become increasingly diverse, tailored to the characteristics of their users.

Several studies on the development of libraries towards new directions using AI seem to include the development of knowledge graphs, automatic classification, and information retrieval. Wei and Liu (2019) conducted experimental design to build a cultural domain knowledge graph. On

the other hand, the use of AI for classification seems to have been initiated. For example, the German National Library has automated the subject cataloging process based on DDC (Mödden 2022), while on the other hand, classification is based on nuclear taxonomy (Santosa 2023). These studies show a trend of direct use of AI to assist in the daily business processes of libraries.

Some studies also point towards development by utilizing NLP and generative AI in libraries to provide services directly to users. Reinsfelder and O'Hara-Krebs (2023) attempted to use pre-prepared and configured responses to build a rule-based chatbot. The use of chatbots is also done using commercially available AI, such as Lehman College's Leonard Lief Library which built a chatbot to be placed on its website using a generative chatbot named Ivy (Ehrenpreis and De-Looper 2022), while at Zayed University Library, Aisha has been developed using the OpenAI API (Lappalainen and Narayanan 2023). In contrast to the use of paid technology, Bagchi (2020) offered the potential use of Rasa Open Source to build chatbots.

Development is not only related to a product that implements AI into a service. Some studies discussed things like policies and conceptual frameworks. Lo (2023) examined how proposals from various countries will impact libraries and provides some recommendations to libraries. While other studies proposed frameworks for libraries of various types to adopt and implement AI (Shahzad et al. 2024; Okunlaya, Syed Abdullah, and Alias 2022; Wójcik 2020).

The development of librarians is also a priority in the increasingly complex library ecosystem with the advent of AI. It raises the question of whether librarians need to directly engage in understanding concepts or equip themselves with programming skills, or if they can collaborate with those who have more expertise in this field. This is also explained by Cox (2024), who outlined several strategies, the first being upskilling existing staff and recruiting new staff. In the first case, this will provide opportunities for current staff to develop with the existing technology, not just in the present with AI. Unlike the previous method of waiting for staff to learn new things, when the need becomes urgent or the workload is excessive, recruiting new personnel can be a wise and quicker choice. Librarians can also learn from various channels and media that are now widely offered, such as community-based examples like AI for Libraries, Archives, and Museums (AI4LAM) and code4lib. It should also be emphasized how librarians, as educators, can later share this knowledge with library users (Andersdotter 2023).

Given the increasing complexity of information and the dependence of AI on data, the important role of librarians in this environment will continue (Cox and Mazumdar 2024). Some roles that librarians can play, such as forming ethical committees, building inclusive policies, developing best practices, and promoting AI literacy (Lo 2023), demonstrate the crucial role of this profession in the midst of the rapidly advancing AI development. On the other hand, it is important to consider the potential impact on librarians in terms of equality, diversity, and inclusion (Cox and Mazumdar 2024), indicating that studies on this topic will continue to evolve.

Conclusion

AI provides a new paradigm for studies in the field of library and information science and opens up opportunities for multidisciplinary studies to uncover various future opportunities. The emergence of ChatGPT marks the beginning of an explosion of studies on AI in libraries. Previously,

studies in this scope were quite low (Wheatley and Hervieux 2020). Studies on how AI can be utilized in services, both directly and behind the scenes, are becoming increasingly discussed. AI and its derivatives also bring new perspectives to the methods used. Studies in the field of library and information science seem to be starting to use some methods commonly used in other fields, such as the utilization of ML and NLP.

The study is not limited to a service product that can be utilized. Considering the diversity of policies and laws, discussions on this topic will continue to evolve, just as libraries can play a role in shaping the process and its impact on libraries. Libraries also need to prepare a framework to explain their position in the AI flow in their respective institutions. It is also important to look at the impact of AI on equality, diversity, and inclusion in libraries (Cox and Mazumdar 2024), in addition to studies on the ability of librarians and libraries to adapt to AI.

This study also provides an overview for libraries to consider the broader perspective of utilizing AI to be applied in their respective places according to their characteristics and uniqueness. In addition, this paper can provide insight into how textual analysis can enrich and provide another perspective in a study related to the use of textual data. Further in-depth studies can also be conducted by utilizing more diverse databases and conducting analysis beyond just titles and abstracts.

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