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Research Article

Application of Natural Language Processing for Improved Information Retrieval in University Libraries in Kebbi State

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ABSTRACT

This study looked into how Natural Language Processing (NLP) can improve information retrieval in university libraries in Kebbi State. A descriptive survey design was used, focusing on 38 processing and ICT librarians from three institutions: AFUSTA, FUBK, and FUAZ. Data were collected through a structured Google Form questionnaire and analyzed using descriptive statistics. The findings showed clear weaknesses in current search systems, especially in dealing with natural language queries and providing relevant results. Respondents pointed out NLP techniques, such as semantic search and query expansion, as good solutions for improving search efficiency and accuracy. Although there was general awareness of the benefits of NLP, the readiness for adoption varied due to issues with infrastructure, training, and policy support. The study concludes that with targeted investment in technology, staff development, and institutional planning, NLP can greatly enhance information retrieval services in Nigerian university libraries.

Keywords: Natural Language Processing (NLP), Information Retrieval (IR), University Libraries, Kebbi State University, Semantic Search, Query Expansion and Relevance Ranking.

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INTRODUCTION

Natural Language Processing (NLP) has become an essential resource for improving information retrieval in university libraries, effectively addressing the increasing difficulties associated with managing and accessing extensive digital collections. The incorporation of NLP methodologies in library systems has greatly enhanced the precision and effectiveness of search operations, allowing users to locate pertinent information with greater ease (Necula *et al*., 2024; Yang and Huang, 2023). Sophisticated NLP approaches, particularly those utilizing Long Short-Term Memory (LSTM) architectures, have demonstrated encouraging outcomes in navigating the intricacies of human language, including its ambiguity and context-sensitive meanings (Yao and Guan, 2018). Such technologies have been especially beneficial in academic environments, where the volume of scholarly publications presents significant obstacles for information retrieval and comprehension (Mayr *et al*., 2017). The use of NLP alongside bibliometric and text mining techniques has created new possibilities for the understanding, analysis, and retrieval of scholarly documents on a large scale, thus improving the functionalities of digital libraries.

The advancement of NLP applications within library contexts has been characterized by the rise of more advanced algorithms and the incorporation of machine learning techniques. Recent research has highlighted the effectiveness of hierarchical machine learning paired with NLP for evaluating text complexity, which has relevance for enhancing resource discovery and accessibility in academic libraries (Balyan *et al*., 2020). Additionally, the advent of cross-modal retrieval systems, like Text2Mol, demonstrates how NLP can connect various types of information, potentially broadening the capabilities of library searches (Edwards *et al*., 2021). The utilization of NLP in analyzing clinical documentation also sheds light on how these technologies can be utilized to extract and organize intricate information from unstructured text, a function that could be adapted to improve the retrieval of specialized academic materials (Liu *et al*., 2020; Newman-Griffis *et al*., 2021). As university libraries persist in digitizing and enlarging their collections, the importance of NLP in supporting efficient information retrieval and knowledge discovery is expected to grow significantly, prompting continued research and development in this area.

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REVIEW OF RELATED LITERATURE

Current search interfaces found in university libraries encounter various limitations that impede effective information retrieval. Conventional keyword-based searches often do not grasp the semantic intricacies of natural language inquiries, resulting in irrelevant or incomplete search results (Jerfy *et al.*, 2024). The inability to comprehend context and user intent can lead to information overload, as users are flooded with an excessive number of results that may not meet their specific requirements (Khalate *et al.*, 2024). Furthermore, these interfaces struggle to manage unstructured data, a considerable portion of library resources that includes full-text articles, theses, and multimedia content (Jerfy *et al.*, 2024; Khalate *et al.*, 2024). The absence of advanced language understanding capabilities also poses challenges in processing complex academic queries or in accommodating variations in terminology across different fields (Glaz *et al.*, 2021; Shankar *et al.*, 2025).

Natural Language Processing (NLP) methods present effective solutions for improving information retrieval systems within libraries. The implementation of semantic search functionalities, supported by approaches like word embeddings and named entity recognition, can enhance the pertinence of search outcomes by grasping the contextual meanings behind queries (Jerfy *et al.*, 2024; Shankar *et al.*, 2025). Machine translation, along with cross-lingual information retrieval, assists in bridging language obstacles, making resources available to a wider audience (Hu *et al.*, 2025; Jerfy *et al.*, 2024). Text summarization techniques can deliver brief overviews of lengthy documents, allowing users to swiftly evaluate the relevance of search results (Abro *et al.*, 2023; Jerfy *et al.*, 2024). Techniques like sentiment analysis and emotion detection can be utilized to assess user feedback, enhancing personalized recommendations (Abro *et al.*, 2023; Glaz *et al.*, 2021). Additionally, incorporating Large Language Models (LLMs) can facilitate advanced question-answering systems and natural language interfaces for library services (Omar *et al.*, 2024).

The readiness of university libraries in Nigeria for the adoption of NLP shows a varied landscape. Although there is an increasing recognition of the possible advantages of NLP technologies, numerous challenges impede broad implementation. The scarcity of digital and computational resources presents considerable barriers, especially in accommodating the various languages spoken across Nigeria (Hu *et al.*, 2025). The COVID-19 pandemic has hastened the transition to digital services in Nigerian academic libraries, with a number of institutions now offering online access to their resources (Fasae *et al.*, 2020). Nonetheless, the emphasis has mainly been on fundamental digital services rather than on advanced NLP applications. The absence of standardized data and the limited NLP research focusing on Nigerian languages further hinder the process of adoption (Hu *et al.*, 2025). In spite of these difficulties, NLP holds promise for improving library services, especially in areas like multilingual information access and tailored user experiences (Hu *et al.*, 2025; Jerfy *et al.*, 2024).

User impressions of NLP-enhanced search tools in library environments tend to be positive, although there is a scarcity of extensive research specifically focused on academic libraries. Users value the enhanced relevance and precision of search results made possible by NLP methods (Khalate *et al.*, 2024; Shankar *et al.*, 2025). The capability to formulate queries in natural language and obtain more contextually relevant responses is regarded as a key benefit over conventional keyword-based approaches (Glaz *et al.*, 2021; Jerfy *et al.*, 2024). Nonetheless, users also voice apprehensions regarding privacy and data security, especially when using AI-driven systems (Glaz *et al.*, 2021; Hu *et al.*, 2025). There is a demand for increased transparency concerning how NLP algorithms handle and analyze user inquiries (Khalate *et al.*, 2024). Furthermore, user research indicates that while NLP-enhanced tools can enhance search efficiency, there remains a learning curve that users must overcome to fully leverage these advanced features (Omar *et al.*, 2024; Shankar *et al.*, 2025). More investigation is necessary to assess the long-term effects of NLP-enhanced search tools on user satisfaction and information-seeking behavior within academic library contexts (Glaz *et al.*, 2021; Omar *et al.*, 2024).

RESEARCH QUESTIONS

What are the limitations of current search interfaces in university libraries?

What NLP techniques are most suitable for library IR systems?

Are Nigerian university libraries ready for NLP adoption?

How do users perceive the effectiveness of NLP-enhanced search tools?

METHODOLOGY

A descriptive survey research design was adopted for this study. The population of the study consisted of 38 processing and ICT librarians from Abdullahi Fodio University of Science and Technology, Aliero (AFUSTA), Federal University Birnin Kebbi (FUBK), and Federal University of Agriculture Zuru (FUAZ). The instrument used for data collection was a structured Google Form questionnaire. The five-point Likert scale was used. A total of 43 links of questionnaires were sent to respondents, out of which 38 responses were received. Descriptive statistics (tables and means) were used to analyze the data generated from the instrument.

RESULTS

The average score of 3.37 indicates that respondents generally agree the current library search interfaces are limited. They especially point out issues with natural language processing,

which received a score of 3.64, and usability, which scored 3.43. Problems like irrelevant results and inadequate language support were noted but received lower agreement. This implies that Nigerian university libraries need smarter and more intuitive interfaces.

With an aggregate score of 3.65, respondents show strong support for NLP-based techniques. They particularly favor keyword matching, which scored 3.96, and semantic search, with a score of 3.78. Other methods, like NER and query expansion, are also seen positively. This indicates a solid awareness and perceived usefulness of certain NLP tools in improving IR systems.

The average mean score (3.23) shows cautious optimism about readiness. While awareness (3.44) and leadership support (3.47) are evident, infrastructure and training are still lacking (2.99), and integration into policy remains weak (2.94). This implies partial readiness and a need for capacity building and strategic planning.

With a strong overall mean of 3.73, respondents show high confidence in the benefits of NLP-enhanced tools. Perceived improvements in access (3.88), relevance (3.75), and willingness to engage (3.84) suggest a positive attitude and readiness to adopt such technologies in academic libraries.

Five significant challenges related to search interfaces were identified and evaluated using a five-point Likert scale, where 1 means Strongly Disagree and 5 means Strongly Agree. The challenge with the highest rating was "Search interfaces lack natural language understanding," which had a mean score of 3.64. This was followed by "Existing interfaces are difficult to use," with a mean of 3.43. Other issues, including Interfaces return too many irrelevant results (Mean = 3.38), Insufficient support for local languages (Mean = 3.22), and Limited mobile responsiveness (Mean = 3.16) were also noted, but with lower mean scores. In summary, the results indicate moderate challenges regarding the usability and effectiveness of current search interfaces (refer to Table 1).

Five main statements about the use of Natural Language Processing (NLP) in university libraries were evaluated and given mean scores based on respondents' perceptions. Each statement was assessed using a five-point Likert scale, where 1 means Strongly Disagree and 5 means Strongly Agree. The results showed that the highest-rated statement was "NLP can improve keyword matching," which received a mean score of 3.96, followed by "Semantic search improves retrieval accuracy," with a mean of 3.78. Other factors, including Named Entity Recognition (NER) helping to identify key information (Mean = 3.59), NLP improving recommendation systems (Mean = 3.49), and Query expansion improving results (Mean = 3.43), were also viewed positively, though their mean scores were slightly lower. These results suggest a generally favorable view of NLP's role in improving information retrieval (Table 2).

Table 1: RQ 1: What are the limitations of current search interfaces in University libraries?

Statement	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)	Mean
Search interfaces lack natural language understanding	8	13	18	29	32	3.64
Existing interfaces are difficult to use	11	16	21	24	29	3.43
Interfaces return too many irrelevant results	10	18	20	28	24	3.38
Poor support for local languages	13	21	18	26	21	3.22
Limited mobile responsiveness	14	17	26	25	18	3.16

Table 2: RQ. 2: What NLP techniques are most suitable for library IR systems?

Statement	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)	Mean
NLP can enhance keyword matching	5	8	13	34	40	3.96
Semantic search improves retrieval accuracy	7	10	16	32	35	3.78
Named Entity Recognition (NER) helps identify key info	9	13	18	30	30	3.59
Query expansion improves results	11	14	21	29	25	3.43
NLP enables better recommendation systems	10	15	20	26	29	3.49

Five factors regarding libraries' readiness for implementing Artificial Intelligence (AI) and Natural Language Processing (NLP) were evaluated using a five-point Likert scale, where 1 means Strongly Disagree and 5 means Strongly Agree. The results showed that the factor with the highest rating was "Leadership is supportive of AI adoption," which had a mean score of 3.47, closely followed by "Library staff are aware of AI/NLP tools" (Mean = 3.44). "The library has infrastructure for AI/NLP" achieved a moderate score (Mean = 3.30). In contrast, lower ratings were found for "Staff have received training on AI tools" (Mean = 2.99) and "NLP is integrated into library policies" (Mean = 2.94), indicating limited readiness in these areas (Table 3).

A five-point Likert scale was used to assess five factors related to the perceived benefits and user acceptance of Natural Language Processing (NLP) in academic libraries, where 1 means Strongly Disagree and 5 means Strongly Agree. The statement with the highest score was "NLP enhances access to academic materials," with a mean score of 3.88, followed closely by "I am open to learning NLP-enabled systems" (Mean = 3.84). Trust in NLP-based tools was moderately high, as shown by the statement "I trust NLP-enhanced search tools" (Mean = 3.67), while efficiency-related factors, such as "NLP decreases search time," received a lower score (Mean = 3.52). Overall, the results suggest a favorable perception of NLP applications in improving access to and relevance of academic resources (Table 4).

MAJOR FINDINGS

The findings revealed that

1. University library users and staff pointed out several challenges with current search systems. These challenges include poor handling of natural language queries, limited relevance of search results, and difficulties in navigating interfaces. All these issues make it hard to access information effectively.
2. Respondents recognized that natural language processing techniques, such as keyword matching, semantic search, and query expansion, are promising tools for improving the accuracy and ease of use of library information retrieval systems.
3. While some institutions have the digital infrastructure and staff awareness needed to explore NLP solutions, many still do not have structured training programs, policy guidelines, and leadership involvement necessary for full adoption.
4. Users are hopeful about the potential of NLP to improve search efficiency, shorten search time, and provide more accurate results. They also showed a willingness to learn and adjust to these new tools if introduced properly.

Table 3: RQ. 3: Are Nigerian university libraries ready for NLP adoption?

Statement	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)	Mean
The library has infrastructure for AI/NLP	13	17	19	29	22	3.3
Library staff are aware of AI/NLP tools	11	16	17	30	26	3.44
Leadership is supportive of AI adoption	10	15	20	28	27	3.47
Staff have received training on AI tools	18	21	22	21	18	2.99
NLP is integrated into library policies	19	22	20	23	16	2.94

Table 4: RQ. 4: How do users perceive the effectiveness of NLP-enhanced search tools?

Statement	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)	Mean
NLP improves access to academic resources	6	10	14	30	40	3.88
NLP tools increase the relevance of search results	8	11	13	34	34	3.75
NLP reduces search time	10	14	18	30	28	3.52
I am willing to learn NLP-enhanced systems	7	10	15	28	40	3.84
I trust NLP-enhanced search tools	9	12	16	29	34	3.67

CONCLUSION

The study shows that library professionals and users are very interested in the benefits of NLP for improving information retrieval in university libraries. Respondents see the limits of current systems, but they also understand the transformative potential of NLP techniques like semantic search, named entity recognition, and query expansion. Still, the readiness for implementation is uneven. This is due to gaps in infrastructure, limited training, and a lack of integrated strategic policy. With the right investment and planning, Nigerian university libraries can successfully move to NLP-enhanced information retrieval systems. This would help meet user needs and improve service delivery.

RECOMMENDATIONS

1. University libraries should invest in search engines that use NLP to support natural language queries, semantic indexing, and personalized results. This investment will address the current weaknesses of keyword-based search systems.
2. Ongoing professional development in AI and NLP should be a priority. This will help library and ICT staff gain the technical skills they need for the successful setup and upkeep of NLP-based systems.
3. Library management should create strategic policies that include the adoption and ethical use of NLP tools. This will help ensure systematic implementation and support from the institution.
4. To implement NLP effectively, universities need to improve their digital infrastructure. This improvement includes increasing server capacity, providing reliable internet access, and ensuring secure data storage to support AI-based information retrieval services.

ABBREVIATIONS

NLP: Natural Language Processing; **IR:** Information Retrieval; **LSTM:** Long Short-Term Memory; **AFUSTA:** Abdullahi Fodio University of Science and Technology, Aliero; **FUBK:** Federal University Birnin Kebbi; **FUAZ:** Federal University of Agriculture Zuru; **LLMs:** Large Language Models; **NER:** Named Entity Recognition; **EMR:** Electronic Medical Records; **ICF:** International Classification of Functioning, Disability and Health; **JMIR:** Journal of Medical Internet Research; **EMNLP:** Empirical Methods in Natural Language Processing; **BIRNDL:** Bibliometric-enhanced Information Retrieval and Natural Language Processing for Digital Libraries; **AI:** Artificial Intelligence; **ICT:** Information and Communication Technology; **RQ:** Research Question; **COVID-19:** Coronavirus Disease 2019; **EMRs:** Electronic Medical Records (plural of EMR).

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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