

MACHINE LEARNING ALGORITHMS AS PREDICTORS OF USER NEEDS IN LIBRARY SYSTEMS IN SOUTH EAST NIGERIA

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ABSTRACT

The study investigated machine learning algorithms as predictors of user needs in library systems in South-East, Nigeria. Two research questions and two null hypotheses guided the study. A survey design was adopted for the study. A sample of 120 study participants from two Universities in South-East were used for the study. An instrument captioned Machine Learning Algorithms as predictors of user Needs in Library Systems (MLAPUNLS) was self-designed and used for data collection. The first section of the instrument focused on demographic variables; while the second part addressed the questionnaire items. The response options include, Strongly Agree, Agree, Disagree and Strongly Disagree. The validity of instrument was ascertained by experts from the department while the reliability index of 0.78 was obtained using test-retest method. The data collected from research questions were analyzed using mean and standard deviation, while the hypotheses were tested with t-test statistics at 0.05 level of significance. Major findings of the study revealed that machine learning algorithms predicts user needs in library systems by analyzing user behavior and offering personalized services to users. It was recommended that library staff should be encouraged to attend trainings to improve their skills.

INTRODUCTION

Machine learning (ML) algorithms have become integral in modernizing library systems by predicting user needs and enhancing service delivery. In South East Nigeria, the adoption of ML can significantly improve user satisfaction and operational efficiency.

ML algorithms analyze vast amounts of data to identify patterns and predict outcomes, enabling libraries to anticipate user needs. For example, recommender systems, a popular ML application, provide personalized suggestions by analyzing user behavior and preferences. This approach enhances the user experience by suggesting relevant resources based on individual interests.

Implementing ML in Nigerian libraries, particularly in the South East region, presents challenges such as limited funding, inadequate infrastructure, and a shortage of skilled personnel. Addressing these challenges is crucial for the successful integration of ML technologies in library systems.

Integrating ML algorithms into library systems in South East Nigeria holds significant promise for predicting user needs and enhancing service delivery. By adopting these technologies, libraries can offer personalized experiences, optimize resource management, and maintain their relevance in the digital age. However, it is essential to address existing challenges through strategic planning, investment, and capacity building to fully realize the benefits of ML in library services.

Statement of the Problem

Libraries play a crucial role in providing information resources to users, yet many library systems in Southeast Nigeria struggle to effectively predict and meet users' evolving needs. Traditional methods of resource allocation and recommendation often rely on static catalogs or manual input, which may not accurately capture user preferences, search patterns, or emerging trends in information-seeking behavior. As a result, users may experience difficulty in accessing relevant materials, leading to underutilization of library resources and reduced satisfaction.

Machine learning algorithms offer a potential solution by analyzing user interactions, borrowing histories, and search behaviors to predict and recommend materials that align with individual preferences. However, the adoption and implementation of such predictive models in Nigerian libraries remain limited due to factors such as inadequate technological infrastructure, lack of expertise, and resistance to change among library staff and users.

This study seeks to explore the effectiveness of machine learning algorithms in predicting user needs within library systems in Southeast Nigeria. It aims to identify the challenges, benefits, and feasibility of integrating such technologies to enhance user experience and optimize library resource management. By doing so, the study hopes to contribute to the modernization of library services, ensuring that users receive timely and relevant information tailored to their needs.

Purpose of the Study

Specifically, the purpose of the study was to :

1. To examine how supervised and unsupervised machine learning algorithms predict user needs in library systems.
2. To examine the relationship between machine learning-based predictions and improved access to research assistance and digital resources in libraries?

Research Questions

The following research questions guided the study:

1. How do machine learning algorithms predict user needs in library systems in tertiary institutions in South-East, Nigeria?
2. How does machine learning based prediction improve research and digital libraries in the tertiary institutions in South-East Nigeria?

Research Hypotheses

The following research hypotheses guided the study:

1. H_{01} : There is no significant difference in the mean scores of IMSU and Anambra State Universities on how machine learning algorithms predicts user needs in library systems.
2. H_{02} : There is no significant difference in the mean scores of Imsu and Anambra state universities on how machine learning-based prediction improves research and digital libraries.

Conceptual Review

Machine learning (ML) algorithms have increasingly been integrated into library systems to anticipate and fulfill user needs, thereby enhancing service delivery. In the context of South East Nigeria, the application of ML in libraries, particularly concerning research assistance and access to digital resources, presents both opportunities and challenges.

Machine Learning in Library Systems

ML algorithms can analyze user behavior and preferences to offer personalized services. For instance, recommender systems utilize collaborative filtering techniques to suggest resources based on users' past interactions, thereby improving information retrieval efficiency . In Nigerian libraries, the adoption of artificial intelligence (AI), which encompasses ML, has been explored to enhance various services, including automated indexing and content management .

ML can be instrumental in identifying patterns in user queries, enabling libraries to proactively offer research assistance. By analyzing frequent topics or common information-seeking behaviors, libraries can tailor their support services to address specific user needs. However, challenges such

as limited technological infrastructure and inadequate staff training in AI applications hinder the effective implementation of these systems in Nigerian academic libraries .

ML algorithms can facilitate improved access to digital resources by predicting user preferences and curating relevant materials. Despite these capabilities, students in South East Nigeria face challenges in accessing and utilizing electronic information resources. Issues such as slow internet speeds, limited computer availability, and inadequate ICT skills have been identified as significant barriers . Addressing these challenges is crucial for the successful integration of ML-driven services in libraries. The deployment of ML in libraries raises ethical concerns, including data privacy and algorithmic bias. Ensuring that user data is handled responsibly and that ML algorithms do not perpetuate biases is essential for maintaining trust and promoting equitable access to information

Integrating ML algorithms into library systems in South East Nigeria holds promise for enhancing research assistance and access to digital resources. However, addressing infrastructural challenges, improving staff competencies, and considering ethical implications are vital steps toward realizing the full potential of ML in these settings.

Theoretical Review

Integrating machine learning (ML) algorithms into library systems can significantly enhance the prediction and fulfillment of user needs. This review examines the Probably Approximately Correct (PAC) Learning framework in machine learning and the Information Foraging Theory concerning user needs in library systems, particularly in the context of South East Nigeria.

Probably Approximately Correct (PAC) Learning

Proposed by Leslie Valiant in 1984, the PAC Learning framework provides a theoretical foundation for understanding the feasibility of learning tasks within computational learning theory. It assesses an algorithm's ability to learn a function that, with high probability, is approximately correct, given specific accuracy and confidence parameters. The framework emphasizes the importance of both the accuracy of the learned model and the computational resources required for learning.

Information Foraging Theory

Developed by Peter Pirolli and Stuart Card in 1999, Information Foraging Theory draws parallels between the food foraging behavior of animals and human information-seeking activities. The theory suggests that users aim to maximize the value of information obtained relative to the effort expended in finding it. Key components include:

Information Scent: Cues that help users estimate the value and cost of accessing information sources.

Information Patch: Clusters of related information that users navigate through before deciding to move to another source.

Applying Information Foraging Theory to library systems involves designing interfaces and search functionalities that align with users' natural information-seeking behaviors, thereby reducing the effort required to find relevant materials.

Relevance to South East Nigerian Libraries

In South East Nigeria, libraries serve diverse user communities with varying information needs. By integrating ML algorithms grounded in the PAC Learning framework, libraries can develop personalized recommendation systems that anticipate user preferences, enhancing the accessibility and relevance of resources.

Incorporating principles from Information Foraging Theory can further optimize library interfaces and search tools, making it easier for users to locate desired information efficiently. This dual

approach not only improves user satisfaction but also promotes greater engagement with library services, addressing challenges such as resource constraints and diverse user needs.

Empirical Review

A study by Funmilola (2024) investigates the application of AI in information retrieval systems within Nigerian libraries. The findings indicate that AI is perceived as a tool to innovate and enhance access to digital resources. However, challenges such as financial constraints, lack of skilled personnel, and limited budgets impede its widespread adoption.

Fabunmi and Akinyemi (2025) assess the influence of AI on library services and user experiences in Nigerian university libraries. Their study reveals a high impact of AI on enhancing library services and improving user satisfaction. They recommend that university libraries integrate AI to achieve more effective service delivery and enriched user experiences.

Adewojo et al. (2025) discuss the transformative role of AI in enhancing user experiences and operational efficiency within Nigerian libraries. They highlight AI's potential in personalizing information access, optimizing search algorithms, and improving knowledge organization. The study also addresses challenges such as limited resources and outdated systems, proposing strategic approaches for successful AI integration.

Bello and Abdulsalam (2023) suggest steps to improve library services through AI in Nigerian libraries. They emphasize the need for infrastructure development, staff training, and addressing ethical considerations to ensure successful AI integration.

While specific empirical studies focusing on machine learning algorithms as predictors of user needs in library systems in South East Nigeria are scarce, existing literature underscores AI's potential to revolutionize library services. Addressing challenges such as funding, infrastructure, and skill gaps is crucial for effective AI adoption. Future research should focus on localized studies to tailor AI applications to the specific needs of libraries in South East Nigeria.

RESEARCH METHODOLOGY

Research Design: The design for the study was a survey design.

Population of the study: The population of the study consisted of 120 library staff in the two selected tertiary institutions in South-East, Nigeria. The selected tertiary institutions are: Imo State University (52) and Anambra State University (68) respectively.

Sample and Sampling Technique: A sample of 120 study participants consisting of 120 study participants consisting of 52 Imo State University library staff and 68 Anambra State University library staff were purposively selected for the study.

Instrument for data collection: data were collected using researcher's self-developed instrument captioned: Machine Learning Algorithms as predictors of user needs in library systems (MLAPUNLS). The instrument had two parts; the first part contained information on the personal data of the respondents while the second part contained the questionnaire items. The items in the second part were on a four point rating scale of Strongly Agree, Disagree and Strongly Disagree.

Validity of the Instrument: The instrument was face and content validated by experts from the department.

Reliability of the Instrument: Test-retest method was used to determine the internal consistency of the research instrument and a coefficient index of 0.78 was obtained.

Method of Data Analysis: The research questions were answered using mean and standard deviation, while the hypotheses were tested using t-test statistics at 0.05 level of significance.

RESULTS

Research Question 1: How does machine learning algorithms predict user needs in library systems in tertiary institutions in South-East, Nigeria?

TABLE 1: Mean and Standard deviation scores on how machine learning algorithms predict user needs in library systems.

S/N	Items	Imsu (52)	Anambra (68)			
		$\bar{x}$	SD	$\bar{x}$	SD	REMARKS
1	Machine learning algorithms and offers personalized services.	2.980	1.726	2.952	1.718	Agreed
2	Machine learning enables library staff to proactively offer research assistance	3.000	1.732	2.779	1.667	Agreed
3	It is instrumental in identifying patterns in user queries.	3.011	1.735	2.882	1.697	Agreed
4	Machine learning algorithms enhances operational efficiency in library systems.	3.007	1.734	3.044	1.744	Agreed
	Aggregate $\bar{x}$ and SD	2.999	1.731	2.914	1.707	Agreed

TABLE 1: Data Analysis revealed that items 1-4 had all the mean scores above the criterion mean 2.5, showing that machine learning algorithms predicts user needs in library systems by analyzing user behavior and offering personalized services, it proactively enables library staff offer research assistance and enhances operational efficiency in library systems.

RESEARCH QUESTION 2: How does machine learning based prediction improve research and digital libraries in the tertiary institutions in South-East Nigeria?

TABLE 2: Mean and standard deviation scores on how machine learning-based prediction improves research and digital libraries.

S/N	Items	Imsu (52)	Anambra (68)			
		$\bar{x}$	SD	$\bar{x}$	SD	REMARKS
5	Machine learning based predictions innovates and enhances access to digital resources.	2.926	1.710	2.882	1.697	Agreed
6	It improves library services and user satisfactions	3.115	1.764	3.017	1.736	Agreed
7	It has the potential to revolutionize library services, if well implemented	3.134	1.770	2.779	1.670	Agreed
8	Machine learning based prediction minimizes data and privacy and algorithms bias	3.041	1.743	2.907	1.704	Agreed
	Aggregate $\bar{x}$ and SD	3.041	1.743	2.907	1.704	Agreed

Table 2: Data analysis indicated that items 5-8 had all the mean scores above the criterion mean of 2.5, showing that respondents are in agreement that machine learning-based prediction improves

research and digital libraries by enhancing access to digital resources and improving library services and user satisfaction by revolutionizing library services.

HYPOTHESES:

Ho₁: There is no significant difference in the mean scores of IMSU and Anambra State Universities on how machine learning algorithms predicts user needs in library systems.

Table 3: t-test analysis of significant difference between Imsu and Anambra State Universities on how machine learning algorithms predicts user needs in library systems.

Respondents	N	$\bar{x}$	SD	DF	t-Cal	t-Tab	Decision
IMSU	52	2.999	1.731	118	0.42	1.96	Not Sig
ANAMBRA	68	2.914	1.707				

In Table 3, the calculated value of 1.96, hence, the null hypotheses was accepted. This shows that there is no significant difference in the mean scores of Imsu and Anambra State universities on how machine learning algorithms predicts user needs in library systems.

Ho₂: There is no significant difference in the mean scores of Imsu and Anambra state universities on how machine learning-based prediction improves research and digital libraries.

Table 4: t-test analysis of significant difference between Imsu and Anambra State Universities on how machine learning-based prediction improves research and digital libraries.

Respondents	N	$\bar{x}$	SD	DF	t-Cal	T-Tab	Decision
IMSU	52	3.041	1.743	118	0.26	1.96	Not Sig
ANAMBRA	68	2.907	1.704				

Analysis of data on table 4 revealed that the calculated value of 0.26 is less than the t-table of 1.96 at 118 degrees of freedom. Hence, the null hypotheses was accepted, showing that there is no significant difference between the mean scores of Imsu and Anambra State Universities on how machine learning-based prediction improves research and digital libraries in tertiary institutions in South-East Nigeria.

DISCUSSION OF RESULTS:

Findings on research question two and hypothesis two revealed that the machine learning algorithms predict user needs, in library systems by analyzing the user behavior and offering personalized services. This findings agrees with Fabunmi and Akinyemi (2025) who affirmed that enhancing the library services improves user satisfaction and information access

Findings on research question two and hypotheses revealed that machine learning-based prediction improves research and digital libraries through innovation and revolutionizing library services. This finding is supported by Fummilola (2024) who stated that machine learning-based prediction is perceived as a tool to innovate and enhance access to digital resources.

CONCLUSION

The integration of machine algorithms in library systems is an innovative strategy aimed at enhancing the efficiency and proficiency of library services. Based on the findings of the study, it could be concluded that machine learning algorithms predicts user needs in library systems by analyzing user behavior and offering personalized services to people. Learning-based predictions improves research and digital libraries by enhancing access to digital resources.

RECOMMENDATIONS

Based on the findings the following recommendations were made:

1. University libraries should integrate artificial intelligence to enhance operational efficiency.

2. Management of Universities should provide robust training programs for library staff to improve their services.

Efforts should be made to introduce digital resources into our library systems to enhance service

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