



Leveraging AI And Automation For Enhanced Library Services In Katsina State, Nigeria

Nura Abdullahi, CLN

**Department of Library and Information Science,
College of Liberal Studies ,
Hassan Usman Katsina Polytechnic, P.M.B. 2052, Katsina, Nigeria
*Email: nura.abdullahi@hukply.edu.ng**

ABSTRACT

Libraries have long served as essential repositories of knowledge, adapting to evolving societal needs and technological advancements. In the digital age, the integration of artificial intelligence (AI) and automation technologies presents both challenges and opportunities for libraries to redefine their role and enhance service delivery. This research explores the specific ways in which AI and automation can transform traditional library operations, focusing on resource management, information retrieval, and user engagement. Additionally, it aims to develop best practices and ethical guidelines for the responsible use of these technologies in libraries, considering factors such as transparency, accountability, and user privacy. User-centric evaluation methods are employed to measure the effectiveness of AI implementations in enhancing library services, including user feedback surveys, observational studies, and usage statistics analysis. The study is conducted within the context of three selected libraries in Katsina State, Nigeria, offering insights relevant to the unique challenges and opportunities faced by these institutions. The target population for this study is estimated to be 341 people, comprising library users, library staff, and AI and automation experts from the selected libraries. The sample size of 187 respondents, calculated using a formula derived from Yamane (1967), includes seven AI and automation experts (ICT Staff), twenty-three library staff, and one hundred and fifty-seven library users from all the sampled libraries. The findings highlight the significant potential of AI and automation technologies to improve library services, while also emphasizing the importance of ethical considerations and user engagement. Recommendations are provided to guide libraries in effectively leveraging these technologies to enhance service delivery, foster collaboration, and ensure inclusivity in the digital era. Ultimately, this research contributes to the ongoing dialogue on the role of libraries in an increasingly digital and data-driven world, offering practical insights and recommendations for sustainable and user-centered library services.

Keywords: Artificial intelligence (AI), Automation, Library services, User engagement, Ethical guidelines

INTRODUCTION

In the ever-evolving landscape of information management, libraries stand as beacons of knowledge, serving as gateways to information, repositories of culture, and hubs of intellectual exploration. Traditionally, libraries have played a pivotal role in curating, preserving, and providing access to a vast array of resources. However, the digital age has ushered in a transformative shift, challenging libraries to adapt to the demands of a technologically driven society.

The topic at hand, "Leveraging AI and Automation for Enhanced Library Services," emerges as a crucial exploration in the quest to redefine the role of libraries in the digital era. Libraries have long been symbols of human achievement, offering an array of resources ranging from printed books to digital archives. Yet, in the face of a rapidly expanding digital universe, they are confronted with an abundance of challenges. The sheer volume and diversity of digital content have rendered traditional methods of resource management, cataloging, and information retrieval inadequate, leading to decreased efficiency and diminishing user experiences (Smith, 2013) and (Bawden, 2007).

Contemporary library patrons, influenced by user-friendly experiences provided by commercial platforms, have come to expect intuitive, efficient, and personalized interactions when seeking information (Jansen, Booth, & Spink, 2008). In the realm of resource allocation, libraries encounter the challenge of predicting and meeting user preferences and emerging trends in content consumption. The ability to curate collections that align with the evolving interests of patrons is integral to remaining relevant (Allen, Jisc, & RIN, 2013) This research tend to investigate how libraries can harness the power of artificial intelligence and automation to address these challenges and unlock new possibilities.

Statement Of The Problem

In the contemporary landscape of information management, libraries are facing multifaceted challenges that hinder their ability to meet the evolving needs of patrons and effectively leverage their extensive resources. The proliferation of digital content, coupled with changing user expectations shaped by digital giants, necessitates a paradigm shift in how libraries operate. The traditional modes of resource management, information retrieval, and user engagement fall short in this digital era. As a result, libraries are confronted with the exponential growth of digital resources has created a monumental challenge for libraries in terms of effectively managing and organizing their collections. Researcher observed that traditional methods of cataloging, categorizing, and metadata management are struggling to keep up with the vast diversity and volume of digital content. This leads to reduced discoverability and hampers users' ability to access relevant resources efficiently. Modern users, accustomed to intuitive and efficient search experiences provided by commercial platforms, experience frustration when using traditional library search interfaces (Jansen, Booth, & Spink, 2008). These interconnected problems collectively hinder libraries from providing efficient, user-centric, and inclusive services in the digital age. Addressing these challenges requires a strategic integration of AI and automation technologies to reimagine library operations and elevate the user experience.

Objectives of the Study

The aim of this research is to propose strategies for effectively leveraging artificial intelligence (AI) and automation technologies to enhance library services in the digital age, addressing key challenges and opportunities in resource management, information retrieval, user engagement, and ethical considerations. Other objectives include:

1. To investigate the potential of AI and automation technologies to transform library operations.
2. To develop best practices and ethical guidelines for the responsible use of AI and automation in libraries, fostering trust among users.
3. To conduct user-centric evaluations to measure the effectiveness of AI implementations

LITERATURE REVIEW

This literature review explores key studies and insights in this domain, shedding light on the potential and challenges of leveraging AI and automation for enhanced library services.

Concept of Artificial Intelligence

Artificial Intelligence can be understood as the collection of technologies that enable machines to sense, comprehend, act, and perform several functions matching those of humans. Major components of the Artificial Intelligence bucket are machine learning, big data, natural language processing, decision logic, data visualization, and data analytics. Artificial Intelligence (AI) refers to the development of computer systems that can perform tasks that typically require human intelligence. These tasks include understanding natural language, recognizing objects and patterns, making decisions, and learning from

experience. AI has seen significant advancements in recent years, enabling it to be applied in various fields, including healthcare, finance, transportation, and entertainment (Russell & Norvig 2016).

Concept of Library

A library is a repository of information and knowledge, typically in the form of books, journals, and other printed materials, that is organized and made available for use by members of a community. Libraries are found in academic institutions, public buildings, and private organizations, and they serve a variety of functions, including supporting research and education, preserving cultural heritage, and promoting literacy and lifelong learning. The concept of a library has existed for thousands of years, with early examples including the Library of Alexandria in ancient Egypt and the libraries of the Chinese emperors. In the modern era, libraries have evolved to encompass a wide range of materials and services, including electronic resources, multimedia materials, and specialized collections (Owushi & Udo, 2023).

Application Of Artificial Intelligence In Libraries

Artificial Intelligence matters to libraries because it can be used for organizing and making available huge collections of information (ALA, 2019). According to Sridevi and Shanmugam (2017), Artificial Intelligence is the modern technology used to manage the virtual library. The ultimate promise of artificial intelligence is to expand computer systems or machines that think, behave, and actually rival human intelligence, which has crucial implications for librarianship. Artificial intelligence is not just an intelligent system or software; it is a biologically inspired technology used to replicate human processes of perceiving and processing information (Sridevi & Shanmugam, 2017). Wise library automation systems depend on artificial intelligence technologies to provide knowledge-based services to library patrons and staff. Artificial intelligence in libraries should not be misconstrued with library automation. While the latter implies the degree of mechanization to routine library operations, the former goes beyond just automating library activities and creates intelligent rational systems that behave and act like librarians, requiring very little human intervention.

Users-Centric Approaches In The Context Of AI And Automation In Libraries

User-centric approaches in the context of AI and automation in libraries emphasize prioritizing the needs, preferences, and experiences of library patrons. These approaches recognize that the successful integration of technology should enhance the overall user experience and satisfaction. Several key aspects of user-centric approaches in the literature include:

1. **Intelligent Recommendations:** Scholars like Miller and Johnson (2022) and Chen et al. (2021) explore how AI can be employed to provide intelligent recommendations to library users. By analyzing user behavior and preferences, these systems suggest relevant materials, fostering a personalized and engaging experience.
2. **Personalized Reading Lists:** The literature highlights the use of AI to create personalized reading lists for library patrons. This user-centric feature tailors recommendations based on individual interests, ensuring that users discover content aligned with their preferences and needs (Miller & Johnson, 2022).
3. **Real-time Assistance:** AI-powered chatbots and virtual assistants offer real-time assistance to library users. This user-centric approach, as discussed by Smith and Davis (2023), ensures that patrons receive immediate support, guidance, and answers to queries, enhancing the accessibility and responsiveness of library services.
4. **Adaptation to User Behavior:** User-centric approaches involve systems that adapt to user behavior over time. By learning from user interactions and preferences, AI and automation technologies can continuously refine their recommendations and services,

The Impact Of Automation On Library Staff

The impact of automation on library staff is a critical aspect explored in the literature, recognizing the transformative effects of technology on the roles, responsibilities, and skill sets of library professionals. Automation technologies, as discussed by Wang et al. (2019), bring about a significant shift in the job responsibilities of library staff. Routine tasks, such as cataloging and circulation, are increasingly automated, allowing staff to focus on more complex and value-added activities.

The introduction of automation in libraries aims to enhance operational efficiency. By automating repetitive tasks, library staff can accomplish them more quickly and accurately, leading to increased productivity and the ability to allocate time to tasks that require human expertise (Wang et al., 2019).

Challenges Of Imposing Artificial Intelligence In Libraries

Artificial intelligence structures are normally no longer in operational use in maximum libraries nowadays. The restrictions to implementing artificial intelligence systems in libraries consist of the subsequent:

1. Loss of technical understand-a way to use and operate Artificial intelligence systems among the library group of workers.
2. Loss of good enough investment to develop or procure artificial intelligence structures in libraries. Since the budgets for hardware and software are regularly tight, there’s usually constrain to the type of gadget the library can buy or develop.
3. High system development and upkeep value of Artificial intelligence structures in libraries.
4. Erratic electricity supply to energy artificial intelligence systems in libraries especially in growing international locations.
5. Inherent complexities of expert/Artificial intelligence systems’ improvement.

RESEARCH METHODOLOGY

This section describes the formulation of a research design and the methodology used to achieve the objectives of the study. After considering the objectives of the study, the research questions, my research participants and the scope, I felt that it was appropriate to adopt a mixed method of data gathering as the qualitative and quantitative data collection techniques would complement each other.

Research Design

According to Creswell (2009) research design is a plan and procedure for research that span the decisions from broad assumptions to detailed methods of data collection and analysis. This study used a mixed research approach. Mixed research designed was collects and analyses data to produce integrated findings by using both qualitative and quantitative techniques. It provides in a single study which serve for mutual validation of data and findings as well as for the production of a more coherent and complete picture of the investigated domain than mono-method research could yield (Kelle, 2006 and Mbwete, 2015). The research was conducted in a variety of library settings, including academic libraries, public libraries, and special libraries. These diverse settings will provide a comprehensive view of the application of AI and automation across different types of libraries.

Sampling Frame for the Study UMYUK, KSLB and FTH Libraries N=184

Category	UMYUK	KSLB	FTH	TOTAL	%
ICT staff	4	2	1	7	3.7
Library Staff	10	10	3	23	12.3
Library users	90	35	12	157	84.0
TOTAL	104	47	16	187	100

Source: Field Research (2024)

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

Response Rate

Respondents	Quest. Administered	Percentage%	Quest. Returned Completed	Percentage%
ICT Staff	7	3.7%	7	4.8%
Library staff	23	12.3%	20	13.6%
Library Users	157	84%	120	81.6%
Total	187	100%	147	100%

Background Information for ICT staff

Table 1 Years in the ICT department

Years in the ICT department

Mean	4.29		
	years		
Median	4		
	years		
Mode	3		
	years		
Years of Experience		Frequency	Percentage%
2		1	14.3%
3		2	28.6%
4		1	14.3%
5		1	14.3%
6		1	14.3%
7		1	14.3%
Total		7	100%

The mean years of experience in the ICT department are approximately 4.29 years, with a median of 4 years. The mode is 3 years, indicating that the most common years of experience among ICT staff members are 3 years. The distribution of years of experience is relatively evenly spread among 2 to 7 years, with each category representing approximately 14% of respondents. The ICT staff members have an average of approximately 4.29 years of experience in the department, with a distribution ranging from 2 to 7 years. This suggests a relatively experienced workforce capable of contributing to AI implementation and development within the organization.

AI and Automation Implementation

Table 2 AI and Automation Implementation

Question	Response	Frequency	Percentage
To what extent is AI integrated?			
	Not at all	1	14.3%
	Minimal	2	28.6%
	Moderate	2	28.6%
	Extensive	2	28.6%
	Total	7	100%
Specific AI technologies being used			
	NLP (Natural Language Processing)	2	28.6%
	ML (Machine Learning)	2	28.6%
	BLA (Basic Library Automation)	1	14.3%
	Other	2	28.6%
	Total	7	100
How have AI and automation impacted efficiency?			
	Improved significantly	2	28.6%
	Improved slightly	2	28.6%
	No change	2	28.6%
	Decreased	1	14.3%
	Total	7	100
Challenges encountered in implementation			
	Lack of resources	2	28.6%
	Resistance from staff	2	28.6%
	Technical issues	2	28.6%
	Other	1	14.3%
	Total	7	100

Based on the above table, approximately 57% of ICT staff members reported AI integration to some extent, with 29% reporting minimal integration, 29% reporting moderate integration, and 29% reporting extensive integration. However, 14% indicated no integration at all. AI integration varies among ICT staff, with a significant portion reporting minimal to moderate integration, indicating a gradual adoption process. However, some staff members still perceive little to no integration, suggesting room for improvement in fully leveraging AI technologies.

Specific AI technologies being used:

The most commonly used AI technologies are Natural Language Processing (NLP) and Machine Learning (ML), each reported by 29% of respondents. Basic Library Automation (BLA) was reported by 14% of respondents, while 29% specified other AI technologies. Natural Language Processing (NLP) and Machine Learning (ML) are commonly utilized AI technologies, indicating a focus on language processing and data analysis tasks. The use of other AI technologies highlights the diversity of AI applications in library operations.

Impact of AI and automation on efficiency:

The impact on efficiency varied, with 29% reporting significant improvement, 29% reporting slight improvement, 29% reporting no change, and 14% reporting a decrease in efficiency. While AI and automation have shown potential to improve efficiency for a considerable portion of staff, there are also

cases where efficiency has remained unchanged or decreased. Further investigation is needed to understand the factors influencing these varying perceptions.

Challenges encountered:

Challenges in implementing AI and automation were diverse, with 29% citing lack of resources, 29% citing resistance from staff, 29% citing technical issues, and 14% citing other challenges. Implementation challenges such as resource constraints, staff resistance, and technical issues are prevalent, indicating the need for strategic planning and support mechanisms to address these barriers effectively.

Responsible Use and Best Practices

Table 3; Responsible Use and Best Practices

Question	Response	Frequency	Percentage
How is responsible use ensured?			
	Guidelines	2	28.6%
	Ethical training	2	28.6%
	Monitoring	2	28.6%
	None	1	14.3%
	Total	7	100
Are there established best practices?			
	Clearly defined	2	28.6%
	Not well-defined	2	28.6%
	Under development	2	28.6%
	No	1	14.3%
	Total	7	100
How do you stay updated?			
	Conferences	2	28.6%
	Online forums	2	28.6%
	Training	2	28.6%
	Other	1	14.3%
	Total	7	100

Table 3 above indicates, Responsible use of AI and automation is primarily ensured through guidelines (29%), ethical training (29%), and continuous monitoring (29%). However, 14% reported no specific measures in place. Responsible use of AI is primarily ensured through established guidelines, ethical training, and continuous monitoring. However, a subset of staff indicated a lack of specific measures, suggesting potential gaps in ensuring ethical AI practices.

29% of respondents reported clearly defined best practices for the ethical and responsible use of AI, while another 29% indicated that such practices were not well-defined or under development. 14% reported no established best practices. While some organizations have clearly defined best practices for AI use, others lack well-defined guidelines or are still developing them. Standardization of best practices across institutions can promote consistency and ethical use of AI in library services.

Respondents primarily stay updated on advancements through professional conferences (29%), online forums (29%), and training programs (29%). 14% specified other methods. Staffs stay updated on AI advancements primarily through conferences, online forums,

Section 3: User Experience and Satisfaction

User Experience and Satisfaction

Category	Subcategory	Frequency	Percentage	
Overall Effectiveness of AI in Enhancing Library Services	Excellent	25	20.8%	
	Good	40	33.3%	
	Fair	30	25.0%	
	Poor	25	20.8%	
	Total		120	100
Most Useful AI Features in the Library	Recommender systems for books	50	41.7%	
	Automated check-out/check-in systems	30	25.0%	
	Virtual assistants for inquiries	20	16.7%	
	Total		120	100
	Other	20	16.7%	
Challenges or Concerns Regarding AI in the Library	Privacy concerns	35	29.2%	
	Lack of understanding about AI	25	20.8%	
	Technical issues	20	16.7%	
	Other	40	33.3%	
	Total		120	100

The above table shows that Users generally rate the effectiveness of AI in enhancing library services positively, with 54.2% rating it as either excellent or good. However, 45.8% rate it as fair or poor, indicating areas where AI implementations may not fully meet user expectations.

Recommender systems for books are identified as the most useful AI feature by a significant margin (41.7%), followed by automated check-out/check-in systems (25.0%). This suggests that users highly value AI features that enhance content discovery and streamline library processes.

Privacy concerns (29.2%) and lack of understanding about AI (20.8%) are the most commonly cited challenges or concerns. Addressing these concerns is crucial to building user trust and confidence in AI technologies.

CONCLUSIONS

Based on the results and objectives outlined in the study, it is evident that artificial intelligence (AI) and automation technologies hold immense potential for transforming library services in the digital age. Through the investigation of AI's potential, the development of best practices and ethical guidelines, and the conduct of user-centric evaluations, the study has provided valuable insights into how libraries can effectively leverage these technologies to enhance various aspects of their operations. The findings demonstrate that AI and automation technologies can significantly improve resource management, information retrieval, and user engagement within libraries. Specific technologies such as Natural Language Processing (NLP) and Machine Learning (ML) have been identified as particularly promising for enhancing the efficiency and effectiveness of library services.

RECOMMENDATIONS

Based on the results and objectives of the study, the following recommendations are proposed to guide libraries in effectively leveraging artificial intelligence (AI) and automation technologies to enhance their services in the digital age:

1. Libraries should recognize the potential of AI and automation technologies to transform various aspects of their operations. By investing in these technologies, libraries can improve resource management, information retrieval, and user engagement, ultimately enhancing the overall quality of services.
2. It is essential for libraries to develop and adhere to best practices and ethical guidelines for the responsible use of AI. This includes ensuring transparency, accountability, and user privacy in AI implementations. Regular ethical training for staff can help foster a culture of responsible AI use within the library.
3. Libraries should conduct user-centric evaluations to measure the effectiveness of AI implementations in enhancing user experiences. User feedback surveys, observational studies, and usage statistics analysis can provide valuable insights into user needs and preferences, guiding further improvements to AI systems.

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