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Evaluation of The Effectiveness of Artificial Intelligence Chatbot in Improving User Experience in Academic Libraries

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ABSTRACT

Academic libraries are increasingly adopting artificial intelligence (AI) technologies to enhance user experience and streamline access to information. This study evaluates the effectiveness of an AI-powered chatbot prototype in improving user interaction with academic library services. A mixed-methods approach was employed, integrating quantitative data from structured Likert-scale questionnaires with qualitative insights from semi-structured interviews. The study involved 120 respondents, including students, faculty, librarians, and ICT staff. Quantitative analysis using SPSS revealed high user satisfaction, with strong ratings for chatbot accuracy, user-friendliness, response time, and ease of access to academic materials. Regression analysis indicated that available resources and existing technological infrastructure were significant, though modest, predictors of chatbot effectiveness ($R^2 = 0.082$, $p < 0.05$). Qualitative findings highlighted the chatbot's role in providing faster responses, improving resource accessibility, and enhancing overall user experience, particularly for open and distance e-learning (ODEL) students. However, participants suggested enhancements in personalization and advanced natural language processing to deliver more tailored interactions. Overall, the findings demonstrate the potential of AI chatbots to significantly improve academic library services and underscore the need for continuous refinement and scalability to meet evolving user needs.

Keywords: Artificial Intelligence, Open Distance, Academic Libraries, Chatbot.

1. INTRODUCTION

Technological advancements in recent years have transformed how organizations deliver services, with artificial intelligence (AI) emerging as one of the most impactful innovations. Companies such as Google and OpenAI have heavily invested in AI systems that leverage natural language processing (NLP) and machine learning (ML) to perform human-like reasoning and address complex problems. A key milestone was the launch of ChatGPT by OpenAI on November 30, 2022, followed by Google's Gemini, which accelerated the adoption of AI across multiple sectors. According to a 2023 Forbes Advisor survey, 64% of businesses believe AI significantly enhances productivity, highlighting growing reliance on AI tools to improve efficiency and user engagement.

The education sector, including libraries, has begun exploring AI integration to improve operations and service delivery (Mou Xiaomin, 2019). Academic libraries, being central hubs for students, faculty, and researchers, provide access to scholarly resources and support research and learning activities (Abubakar & Kabir, 2022). However, many libraries still depend on legacy systems for information retrieval and user support, such as human-assisted virtual chat systems that are not available 24/7. This creates challenges such as long wait times, difficulty in locating resources, and lack of personalized assistance, particularly for part-time and distance-learning students. These limitations negatively impact user satisfaction and overall library engagement.

In today's digital era, user experience (UX) has become a crucial element in library service delivery. UX encompasses factors such as ease of use, accessibility, and user satisfaction when interacting with library systems (Yang et al., 2020). Studies show that positive UX enhances library engagement and loyalty (Peng et al., 2022), while negative experiences often result in frustration and decreased usage. Technological innovations such as self-checkout systems, intuitive online catalogs, and expanded digital collections have improved UX by streamlining access to resources and services (Sadiq & Bagudu, 2012). Post-COVID-19, libraries increasingly offer remote access to e-books, journals, and digital resources, emphasizing the need for more interactive and user-centric service models.

AI chatbots are emerging as a transformative technology in this context. Defined as software applications that simulate human conversation through text or voice (Gupta et al., 2020), chatbots are widely used in sectors such as banking, healthcare, and education to deliver real-time, virtual support (Nawaz & Saldeen, 2020). In academic libraries, chatbots have been leveraged for cataloging tasks, such as generating subject headings and classification numbers (Adetayo, 2023), as well as for selective dissemination of information (SDI) and virtual reference services (Sanji et al., 2022). These applications demonstrate the potential of AI chatbots to enhance accessibility, streamline service delivery, and provide personalized user support.

While the integration of AI chatbots in libraries is gaining momentum globally, there is limited research on their implementation and impact within academic libraries in the Nairobi Metropolitan region. This study therefore seeks to evaluate the effectiveness of AI chatbots in enhancing user experience in academic libraries, focusing on three selected universities. By assessing their adoption, user perceptions, and operational impact, this research aims to provide insights into the benefits, challenges, and best practices for integrating AI-driven solutions into library systems.

1.1 Statement of the Problem

Academic libraries play a critical role in supporting students, faculty, and researchers by providing access to academic resources and information services. However, many libraries still rely on legacy systems for information retrieval and user

support, such as human-assisted virtual chat services that are not available 24/7. These outdated systems often lead to long wait times, difficulty in accessing relevant resources, and limited personalized support, particularly affecting part-time and open-distance learning students (Mutanana & Pedzisai, 2020). Such limitations negatively impact user experience and hinder the libraries' ability to meet diverse user needs effectively. While artificial intelligence (AI) chatbots present opportunities for personalized assistance, real-time access, and improved user engagement, their integration into academic library systems remains underexplored in the local context. This study addresses the gap by evaluating the effectiveness, user acceptance, and challenges of implementing AI chatbot technology in academic libraries, focusing on three selected universities.

2. LITERATURE REVIEW

2.1 Current Landscape of Artificial Intelligence in Libraries

Concept and evolution.

AI is broadly the design of machines that emulate human cognition—learning, pattern recognition, language understanding, reasoning, and decision-making ((Monett et al., 2020,Gil de Zúñiga et al., 2024). Its intellectual roots trace to Leibniz's *calculus ratiocinator* and Babbage's Analytical Engine as a programmable architecture(Peckhaus, 2004). Modern AI research coalesced at the 1956 Dartmouth workshop (Haenlein & Kaplan, 2019), leading to rule-based systems and early conversational agents like ELIZA (Gupta et al., 2020), alongside foundational work on the Turing Test (French, 2000). Constraints in knowledge engineering and compute capacity produced cycles of optimism and slowdown, until advances in algorithms, backpropagation, data, and hardware catalyzed the deep-learning era ((Delipetrev et al., 2020; Richbourg, 2018), 2018). These advances now underpin image recognition (Vats, 2022), NLP and sentiment analysis (Panda & Chakravarty, 2022)and mass-market assistants (Siri, Cortana, Google Assistant), with contemporary general-purpose chatbots such as ChatGPT and Gemini. Regionally, deployments like Kudi in Nigeria and Safaricom's Zuri in Kenya show localized value creation (Okolo et al., 2023).

Library applications.

Libraries in the North America have experimented with chatbots for more than a decade: the University of Nebraska's "Pixel" (Allison, 2011), and institutional bots such as OCLC's "Lilian," and Hamburg State University Library's "Darcy" and "Stella" (Gujral et al., 2019). Reported use cases include virtual reference, directional help, hours/policies queries, SDI, and elements of technical services like subject assignment and classification support (Sanji et al., 2022; Adetayo, 2023). Collectively, studies highlight potential benefits 24/7 availability, faster responses, reduced routine workload, and improved wayfinding while cautioning about accuracy, transparency, and escalation to humans for complex needs.

User experience (UX) outcomes.

UX captures ease, accessibility, satisfaction, engagement, and sustained use within library touchpoints (Yang et al., 2020). Evidence links better UX to higher usage and loyalty (Peng et al., 2022), while self-service tools and intuitive catalogs improve satisfaction and throughput (Sadiq & Bagudu, 2012; Eserada & Okolo, 2019). Post-COVID digital collections expanded expectations for remote, responsive support. In this milieu, AI chatbots can personalize interactions and shorten time-to-answer, but misinterpretation of queries and opaque limitations can erode trust (Chaurasia et al., 2023; Nicolescu & Tudorache, 2022). Personalization generally improves perceived helpfulness and trust (Patel & Trivedi, 2020; Araujo & Bol, 2024), provided transparency and fallback paths are clear (Cheng & Jiang, 2020).

2.2 The Conversational Age: Infrastructure & Resources for Chatbot Implementation

The successful implementation of chatbots in academic libraries requires a robust infrastructure encompassing hardware, software, networking, natural language processing (NLP) capabilities, machine learning (ML) design, datasets, and cloud services. On the hardware side, even small on-premise chatbots benefit from modern multi-core CPUs and solid-state drives (SSDs), while larger or ML-intensive setups demand server-grade processors, GPUs, and high-capacity RAM to handle NLP pipelines and concurrent user sessions (Talib et al., 2021; Singh & Thakur, 2020; Ramakrishna & Maha, 2020; Borsci et al., 2023; Johari et al., 2022; Henry et al., 2020). Mature ML frameworks such as TensorFlow, Keras, and PyTorch accelerate model development and deployment, with the choice of platform largely depending on team expertise and compatibility with existing systems (Ali et al., 2020; Chowdhury et al., 2023; Gao et al., n.d.; You et al., n.d.).

Networking and integration are equally critical, as effective chatbots must securely connect to integrated library systems (ILS), electronic resource management systems (ERMS), online public access catalogs (OPAC), and authentication platforms to provide accurate responses to resource availability, account inquiries, and policy-related queries (Okonkwo & Ade-ibijola, 2021; Nawaz & Saldeen, 2020; Kaushal & Yadav, 2022; Skrebeca et al., 2021). NLP capabilities play a pivotal role in enabling intent detection, entity extraction, dialogue management, and response generation, while advanced text classification and recommendation mechanisms leverage labeled data and user interaction patterns to enhance resource retrieval and personalization (Barberá et al., 2021; X. Luo, 2021; Khurana et al., 2023). Successful chatbot design also requires clear domain scoping, well-structured conversation flows, and robust data strategies, with iterative updates to accommodate evolving user intents and expanding resource collections (Adamopoulou & Moussiades, 2020; B. Luo & Li, 2022; Matic et al., 2021; Trappey et al., 2020; McTear, 2020; Bowman & Dahl, 2021).

The quality and diversity of training datasets significantly influence performance; limited or homogeneous datasets often result in rigid, less responsive systems, whereas rich datasets containing varied intents, phrasing, and annotations produce more adaptive and accurate interactions (Suta et al., 2020; Glennie et al., 2023; L. Xu et al., 2021; Kusal et al., 2022; Alaaeldin et al., 2021). Finally, cloud-based platforms such as Azure Bot Service with Language Understanding Intelligent Service (LUIS) and Amazon Web Services' Lex and Polly offer scalable, flexible, and well-documented environments for chatbot deployment, reducing infrastructure maintenance while providing advanced NLP, speech synthesis, and integration capabilities (Ray & Mathew, 2020; Psomakelis et al., 2020; Haile, 2022; Jagatheesaperumal et al., 2022).

Adoption in African Academic Libraries

Despite global momentum, African academic libraries show slower uptake due to infrastructure constraints, skills gaps, and policy/ethics concerns (Abba, 2023). Studies indicate staff and students understand AI concepts, yet perceive insufficient institutional support, training, and guidance on practical applications within libraries (Jelagat Sang & Macharia, n.d.). This underscores the need for context-aware implementations aligned to local infrastructure, digital literacy, and governance.

2.3 Theoretical Framework

User-Centered Design (UCD) / HCI.

UCD emphasizes iterative discovery of user needs, prototyping, accessibility, and participatory design—crucial for trust, usefulness, and inclusivity. Library chatbot projects (e.g., "Pixel," OCLC's "Lilian") benefited from iterative testing and

dialogue flow refinement; accessibility and inclusivity should be first-class requirements (Allison, 2011; Gujral et al., 2019; Okolo et al., 2023). Participatory approaches mitigate concerns about privacy, trust, and loss of human touch (Cox et al., 2019). Lack of consultation and limited digital-literacy training are barriers (Afolabi & Madu, 2021).

Technology Acceptance Model (TAM).

Perceived usefulness and ease of use drive attitudes and intention to use. In library settings, users value chatbots that speed access to resources, answer reference queries, and integrate smoothly with research workflows; intuitive conversational interfaces and reliable outputs strengthen acceptance and recommendations (Haugeland et al., 2022; Araujo & Bol, 2024; Cheng & Jiang, 2020; Masri et al., 2020). Communicating scope/limits and providing support resources further improves attitudes and trust.

2.4 Summary of Research Gaps

i. Context-specific evidence: Few empirical studies in Kenyan and broader African university libraries examining end-to-end chatbot implementation, UX outcomes, and service quality impacts (Abba, 2023; Jelagat Sang & Macharia, n.d.).
ii. Data & evaluation: Limited, domain-specific training datasets and shared evaluation protocols for library intents (circulation, e-resources, policies).
iii. Integration & governance: Underexplored interoperability with legacy OPAC/ILS/ERMS, privacy, transparency, and escalation policies in resource-constrained environments.
iv. Capacity building: Gaps in staff training, digital literacy programs, and participatory design processes to sustain adoption.

3. METHODOLOGY

Research Design

This study employed a **mixed-methods research design**, integrating both quantitative and qualitative approaches to provide a comprehensive evaluation of the AI chatbot's effectiveness in improving user experience in academic libraries. The quantitative component measured user perceptions through structured questionnaires, while the qualitative component explored deeper insights from semi-structured interviews with key stakeholders.

Study Area and Population

The study was conducted across **three university libraries** within the Nairobi Metropolitan Area. These libraries were selected due to their diverse user populations and ongoing efforts toward digital service enhancement. The target population included students, library staff, faculty members, and ICT personnel actively engaged in library services.

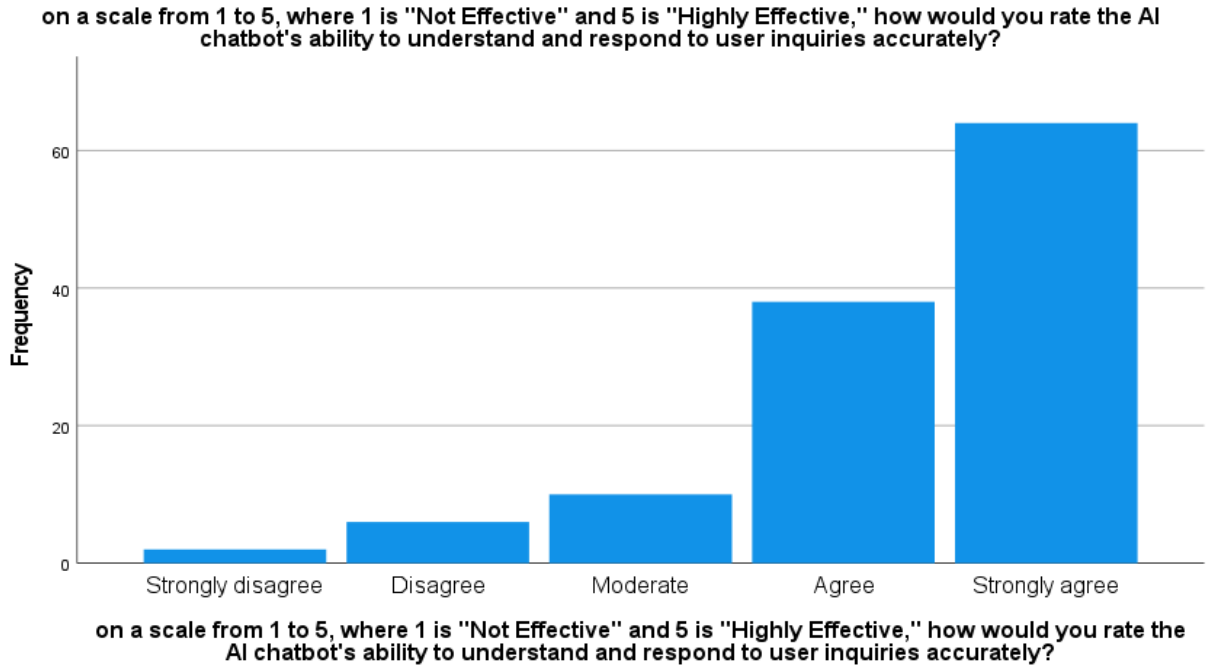
Sample Size and Sampling Techniques

A total of 120 participants were involved in the study. The respondents comprised:
Students (n = 45), with a significant proportion from Open, Distance, and e-Learning (ODEL) programs.
Library staff (n = 30) actively managing library services.
Faculty members (n = 20) who regularly interact with library systems.
ICT personnel (n = 10) responsible for the technical integration of library systems.
Stratified and systematic random sampling was applied for selecting students to ensure proportional representation, while purposive sampling targeted faculty, ICT staff, and librarians due to their specialized knowledge and involvement in AI technology implementation.

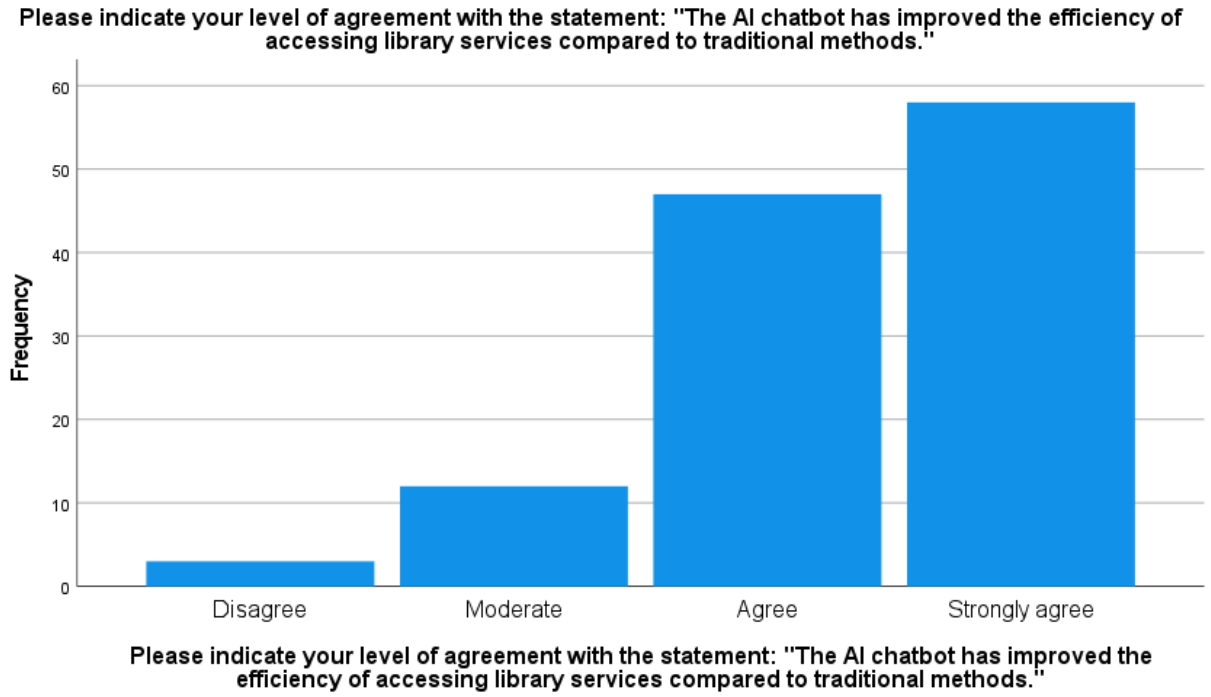
4. FINDINGS

The objective examined the perceived effectiveness of AI chatbots in improving library user experiences. Table 4.3.2 summarizes responses on chatbot accuracy, response time, efficiency, research assistance, personalization, and overall satisfaction.

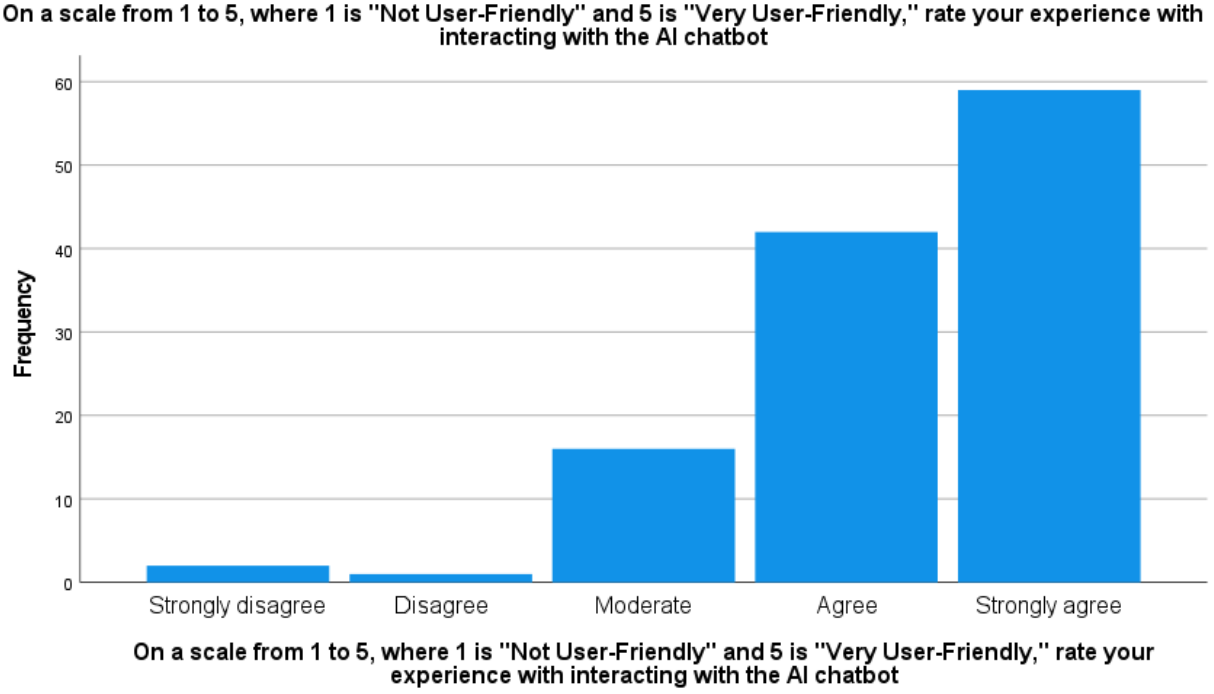
The section here assessed how users perceived the effectiveness of AI chatbots in improving their library service experience. Results indicated a generally favorable view, with 53.3% of respondents strongly agreeing and 31.7% agreeing that the chatbot effectively understands and responds to inquiries, yielding a high overall accuracy rating (SD = 0.940). Satisfaction with response time was also positive, with 33.3% strongly agreeing and 37.5% agreeing, although 23.3% reported only moderate satisfaction (SD = 0.943).



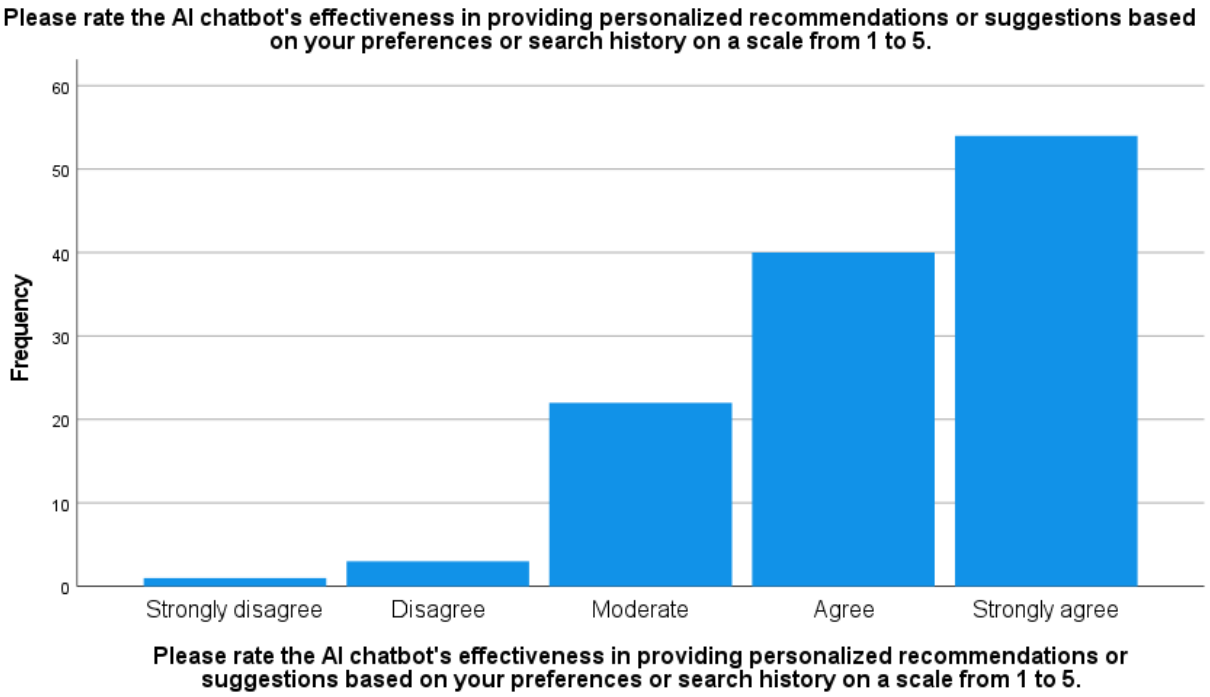
When evaluating service efficiency compared to traditional methods, 48.3% strongly agreed and 39.2% agreed that the chatbot improved accessibility to library services (SD = 0.760). In terms of research assistance, 43.3% strongly agreed and 36.7% agreed that the chatbot was effective, though 15% rated it only moderately effective (SD = 0.920).



User-friendliness received strong ratings, with 49.2% strongly agreeing and 35% agreeing (SD = 0.854). Similarly, 40.8% strongly agreed and 37.5% agreed that the chatbot enhanced their overall library experience (SD = 0.992). Likelihood of recommending the chatbot was high, with 39.2% strongly agreeing and 40.8% agreeing (SD = 0.938).



On personalization, 45% strongly agreed and 33.3% agreed that the chatbot provided relevant suggestions (SD = 0.882), though 18.3% indicated only moderate effectiveness in this area. Finally, 49.2% strongly agreed and 32.5% agreed that the chatbot contributed to a more enjoyable and efficient experience overall, with minimal disagreement (SD = 0.857).



Overall, these findings demonstrate strong user approval of AI chatbot functions, particularly in accuracy, user-friendliness, and service efficiency, while highlighting personalization as an area with room for further improvement.

The results indicate that the chatbot significantly enhances user engagement by improving service accessibility, providing accurate assistance, and offering intuitive interfaces. However, personalization remains a critical area for future development. This is consistent with Yang et al. (2020), who emphasized that personalization drives deeper user satisfaction in digital service platforms.

4.2 Conclusion

These findings support existing literature Gupta & Reddy, (2020), which suggests that chatbots excel in routine query handling and efficiency improvement but often lag in adaptive personalization and deep contextual understanding.

4.3 Recommendation

To ensure the successful integration of AI chatbots in university libraries, infrastructure investment is essential, with universities prioritizing funding for robust technical infrastructure and software development. Additionally, clear policies and compliance frameworks on data privacy and ethical AI use should be established before large-scale deployment to safeguard user trust and security. Comprehensive training and awareness programs for both library staff and users are also crucial to maximize efficiency and foster acceptance of the technology. Furthermore, efforts should be made to enhance personalization by improving natural language processing capabilities, allowing chatbots to better meet the unique needs of individual users. Finally, libraries should actively adopt innovative AI tools to keep pace with global technological advancements and maintain their relevance in an evolving digital landscape.

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