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ARTIFICIAL INTELLIGENCE IN LIBRARY SERVICES: ADVANCING QUALITY EDUCATION THROUGH SMART INFORMATION SUPPORT

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Abstract

Artificial Intelligence (AI) is rapidly transforming information management and educational environments by enabling intelligent automation, improved information retrieval, and personalized knowledge services. University libraries, as central knowledge hubs within higher education institutions, are increasingly exploring the use of AI technologies to enhance service delivery, support research activities, and improve access to information resources.

The primary objective of this study was to examine the level of awareness and knowledge of AI among university library professionals in Pakistan, identify current AI applications in library services, analyse the perceived role of AI in promoting quality education, assess institutional readiness for AI adoption, and explore the major challenges and future prospects associated with AI implementation in academic libraries.

This study employed a quantitative research design using a structured questionnaire distributed among library professionals working in university libraries across Pakistan. A total of 277 respondents participated in the survey. Data were collected using a five-point Likert scale and analysed using descriptive statistical techniques including frequencies and percentages to identify patterns and trends related to AI adoption in library services.

The findings reveal that 70.8% of respondents were familiar with the concept of AI and 63.9% reported understanding its applications in library services. A strong majority agreed that AI improves library operations, including cataloguing (70.8%), information retrieval efficiency (77.3%), and digital library services (79.8%). Regarding the role of AI in education, 75.1% believed it improves learning outcomes, 81.6% agreed that it assists researchers, and 78.3% indicated that it enhances academic productivity. However, respondents also identified key barriers such as high implementation cost (82.7%), lack of technical expertise (75.8%), data privacy concerns (72.2%), and insufficient training opportunities (70.7%), while 82.7% emphasized that continuous AI training is necessary for future adoption. The study concludes that although university libraries in Pakistan demonstrate growing awareness and positive attitudes toward AI technologies, effective implementation requires stronger institutional support, improved technological infrastructure, strategic policy development, and continuous professional training for library professionals. Strengthening collaboration between libraries and information technology departments will be essential for facilitating sustainable AI integration and enhancing the role of academic libraries in advancing quality education.

Keywords: Artificial Intelligence (AI), Academic Libraries, Library Services, Quality Education, Information Retrieval, Digital Libraries, AI Applications, Institutional Readiness, Library Professionals, Higher Education.

1. Introduction

Artificial Intelligence (AI) has emerged as a transformative force across diverse sectors, including

education, healthcare, business, and information management. In the context of higher education, university libraries are increasingly integrating AI-based tools and systems to enhance service delivery, improve operational efficiency, and support academic excellence (Jha, 2023; Panda & Chakravarty, 2022; Shahzad et al., 2024). As knowledge hubs within universities, libraries play a vital role in facilitating teaching, learning, and research activities (Barsha & Munshi, 2024). The rapid growth of digital information, evolving user expectations, and the demand for personalized services have compelled libraries to rethink traditional service models and adopt intelligent technologies that can respond dynamically to users' needs (Hamad et al., 2023).

In Pakistan, university libraries are gradually transitioning from conventional systems to digital and hybrid environments (Ali et al., 2024). The integration of AI technologies such as machine learning algorithms, natural language processing, chatbots, recommendation systems, automated cataloguing, and plagiarism detection tools has the potential to revolutionize information access and management (Asalm et al., 2025; Ali et al., 2021). AI-powered systems can analyze large datasets, predict user preferences, automate repetitive tasks, and enhance decision-making processes (Islam et al., 2025). These capabilities not only improve internal library operations but also contribute significantly to user satisfaction and quality education outcomes (Asim et al., 2023).

Professional librarians are central to the successful implementation of AI in library settings. Their awareness, knowledge, technical competencies, and attitudes toward AI technologies influence the extent to which these innovations are effectively adopted (Bi et al., 2022). While some library professionals view AI as an opportunity to modernize services and strengthen their professional roles, others may perceive it as complex, resource-intensive, or even threatening to traditional practices (Praveenraj et al., 2025). Therefore, understanding librarians' perceptions, institutional readiness, and the challenges associated with AI adoption is crucial for informed decision-making and strategic planning (Patris et al., 2025).

AI applications in library services extend to various operational domains. Intelligent cataloguing systems enhance metadata accuracy and consistency, thereby improving resource discoverability. AI-based information retrieval tools increase search precision and relevance, enabling users to locate scholarly materials efficiently (Yusuf et al., 2022). Virtual assistants and chatbots provide instant user support, reducing response time and enhancing service accessibility beyond physical library hours (Asemi et al., 2021). Furthermore, automated indexing and classification systems minimize manual workload, allowing professionals to focus on advanced research support and academic engagement activities (Ogwo et al., 2023).

The integration of AI also aligns with the broader objective of advancing quality education. Smart library systems support personalized learning experiences by recommending tailored resources based on user behavior and academic interests (Sajja et al., 2024). AI-driven analytics assist researchers in identifying emerging trends and relevant scholarly works. Additionally, accessibility features powered by AI technologies benefit users with special needs by providing adaptive interfaces and voice-based search functionalities (George & Wooden, 2023). In this regard, AI-enabled libraries contribute to inclusive education and academic productivity.

Despite its promising advantages, AI implementation in university libraries is not without challenges (Huang, 2024). Limited financial resources, insufficient technical infrastructure, lack of specialized training, data privacy concerns, and resistance to organizational change can hinder successful adoption (Tait & Pierson, 2022). Institutional support, strategic policies, and collaboration between library and IT departments are essential for overcoming these barriers (Yoon et al., 2022). Assessing institutional readiness and identifying perceived challenges provide valuable insights into the current state of AI integration within Pakistani university libraries.

The findings of this study are expected to support policymakers, university administrators, and library leaders in developing strategic frameworks for AI adoption. Furthermore, the study highlights the evolving role of librarians in the digital era and emphasizes the need for continuous professional development in emerging technologies. As university libraries strive to remain relevant in an increasingly data-driven academic environment, AI integration represents not merely a technological upgrade but a strategic transformation toward smarter information ecosystems.

Problem Statement

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The rapid advancement of Artificial Intelligence (AI) has significantly transformed information management practices worldwide, particularly in the context of digital knowledge environments and higher education institutions. Academic libraries, traditionally responsible for organizing, preserving, and disseminating scholarly information, are increasingly expected to adopt intelligent technologies that enhance information retrieval, automate routine processes, and support advanced research activities. AI-based systems such as machine learning algorithms, natural language processing, recommendation engines, and automated cataloguing tools have demonstrated considerable potential to improve the efficiency, accessibility, and responsiveness of library services.

Despite these technological advancements, the integration of AI within university libraries in developing countries remains uneven and insufficiently explored. In Pakistan, many academic libraries are still transitioning from traditional service models toward digital and hybrid information systems. While global research highlights the transformative potential of AI in improving library operations and supporting quality education, empirical evidence regarding the actual readiness of Pakistani university libraries to adopt such technologies remains limited. In particular, there is a lack of systematic investigation into librarians' awareness and knowledge of AI, the current level of AI application in library services, institutional readiness in terms of infrastructure and policy support, and the practical challenges that hinder effective AI implementation.

Furthermore, the absence of comprehensive data on these factors creates difficulties for policymakers, university administrators, and library managers when attempting to develop strategic plans for technological innovation. Without a clear understanding of the perceptions, competencies, and institutional conditions surrounding AI adoption, efforts to modernize library services may remain fragmented and reactive rather than strategic and sustainable.

Therefore, there is a critical need to investigate the current status of AI awareness, applications, institutional readiness, challenges, and future prospects within university libraries in Pakistan. Such an investigation will provide evidence-based insights that can guide strategic planning, capacity building, and policy development aimed at integrating AI technologies to enhance library services and contribute to the advancement of quality education in higher education institutions.

2. Literature Review

Artificial Intelligence in Library Services

Artificial Intelligence has significantly influenced the evolution of library services worldwide. AI technologies such as machine learning, expert systems, natural language processing, and data mining have enhanced information organization and retrieval processes. Social media is now the power of library field to elobrate their resources and services (Ullah, 2026). According to Hussain (2025), AI refers to the science and engineering of making intelligent machines capable of performing tasks that normally require human intelligence. In library environments, AI applications include automated cataloguing, metadata generation, and semantic search systems, which improve efficiency and reduce human error (Lakho et al., 2025).

Studies indicate that AI-driven systems can enhance accuracy in classification and indexing processes while minimizing repetitive manual work. Research by Jabeen et al., (2025) highlights that intelligent systems can learn from data patterns and optimize performance over time. This adaptive capability is particularly valuable in digital libraries where large volumes of information require systematic management.

AI and Information Retrieval

Information retrieval is a core function of academic libraries. AI-based search engines use algorithms to refine search results and provide personalized recommendations (Hersh, 2024). Intelligent retrieval systems analyze user behavior and search history to predict relevant resources, thereby improving user satisfaction (Huang & Huang, 2024). Empirical studies demonstrate that AI-enhanced discovery tools significantly reduce search time and increase retrieval precision (Liu et al., 2022). Chatbots and virtual assistants have also been adopted in libraries to provide real-time responses to user queries, enhancing accessibility and service responsiveness.

AI and Quality Education

AI integration in libraries supports the broader educational mission of universities. By facilitating personalized learning pathways and resource recommendations, AI systems contribute to improved academic

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performance (Harry & Sayudin, 2023). Scholars argue that AI-enabled libraries align with global educational goals, including equitable access to knowledge and inclusive learning environments (Susanti et al., 2025). Intelligent plagiarism detection tools and research analytics platforms further strengthen academic integrity and research quality (Schiff, 2022).

Moreover, AI technologies enhance accessibility for users with disabilities by offering voice recognition, automated text-to-speech services, and adaptive interfaces. These innovations ensure that library services are inclusive and responsive to diverse user needs.

Institutional Readiness and Challenges

Despite the advantages of AI, institutional readiness remains a critical determinant of successful implementation. Adequate infrastructure, financial investment, policy frameworks, and skilled personnel are essential components of readiness (Yang, 2021). Studies reveal that many developing countries face budgetary and technical constraints that limit AI adoption. Data privacy and cybersecurity concerns also pose significant challenges, as AI systems rely heavily on user data for optimization (Zhai et al., 2021).

Resistance to change among staff and lack of specialized training can further impede AI integration (Ayeni et al., 2024). Continuous professional development programs are recommended to equip librarians with necessary digital competencies. Collaborative efforts between IT departments and library management are also crucial to ensure seamless system implementation and maintenance (Seth & Kaushik, 2025).

Overall, the literature suggests that while AI presents transformative opportunities for academic libraries, strategic planning, policy support, and capacity building are essential for sustainable integration.

Research Questions

1. What is the level of awareness and knowledge of AI among university library professionals in Pakistan?
2. How are AI applications currently utilized in university library services?
3. How does AI integration contribute to quality education in higher education institutions?
4. What is the level of institutional readiness for AI implementation?
5. What challenges hinder effective AI adoption in university libraries?
6. What are the future prospects of AI in Pakistani university libraries?

Research Objectives

1. To examine the awareness and knowledge of AI among library professionals.
2. To identify current AI applications in university library services.
3. To analyze the perceived impact of AI on quality education.
4. To assess institutional readiness and infrastructural support for AI integration.
5. To explore major challenges associated with AI implementation.
6. To evaluate future prospects and strategic directions for AI adoption.

3. Methodology

Research Design

This study adopted a quantitative research design (Islam et al., 2025; Jabeen, 2025; Lakho et al., 2025; Shahzad et al., 2024) to examine the awareness, applications, institutional readiness, challenges, and future prospects of Artificial Intelligence (AI) in university library services in Pakistan. A survey-based approach was considered appropriate because it allows researchers to collect standardized data from a large number of respondents and analyze their perceptions systematically. The quantitative method enabled the researcher to measure librarians' attitudes and experiences regarding AI technologies through structured questions and statistical analysis.

Population of the Study

The population of the study consisted of library professionals working in university libraries across Pakistan. These professionals include individuals holding positions such as library assistants, assistant librarians, librarians, deputy librarians, and chief librarians. Since these professionals are directly involved in library operations, information management, and user support services, they are considered key stakeholders in the adoption and implementation of AI technologies within academic libraries.

Sample Size and Sampling Technique

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A total of 277 library professionals participated in this study. The sample included respondents from both public and private universities, providing a balanced representation of different institutional environments. A convenience sampling technique was used to collect responses from accessible participants who were willing to contribute to the research. This approach enabled the researcher to gather relevant data efficiently from professionals actively working in university libraries.

Data Collection Instrument

Data were collected using a structured questionnaire designed specifically for this study. The questionnaire consisted of two main sections. The first section gathered demographic information of the respondents, including gender, age group, educational qualification, type of university, professional experience, and current position.

The second section included statements related to awareness and knowledge of AI, AI applications in library services, the role of AI in quality education, institutional readiness, challenges of AI implementation, and future prospects of AI adoption. Responses were measured using a five-point Likert scale, where 1 represented Strongly Disagree (SD), 2 represented Disagree (D), 3 represented Neutral (N), 4 represented Agree (A), and 5 represented Strongly Agree (SA).

Data Collection Procedure

The questionnaire was distributed among library professionals working in university libraries through online communication channels (Google Form) and professional networks (Jabeen, 2025). Participants were informed about the purpose of the study and were assured that their responses would be used strictly for academic research purposes. Participation was voluntary, and respondents were encouraged to provide honest and accurate responses based on their professional experiences and perceptions regarding AI technologies in library services.

Data Analysis Techniques

The collected data were organized, coded, and analyzed using descriptive statistical techniques. Frequencies and percentages were calculated to summarize respondents' opinions and perceptions regarding AI adoption in university libraries. The results were presented through tables and figures to provide a clear and systematic representation of the data. These statistical summaries helped identify patterns, trends, and relationships related to awareness, institutional readiness, perceived benefits, and challenges associated with AI implementation in academic library environments.

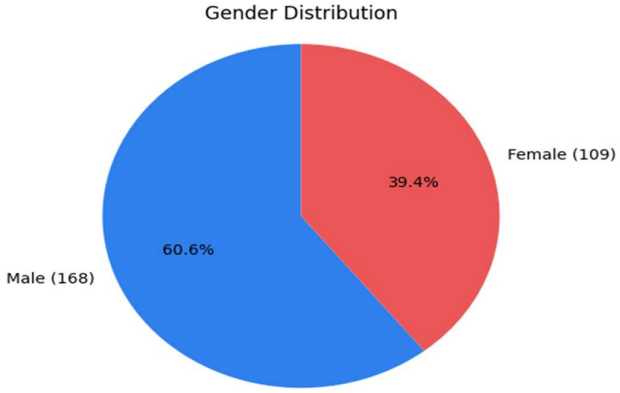
4. Data Analysis

Data Analysis is the systematic process of organizing, examining, and interpreting collected data in order to discover meaningful patterns, relationships, and insights. It involves techniques such as classification, tabulation, and statistical evaluation to transform raw data into useful information. In research, data analysis helps researchers draw conclusions, answer research questions, and support decision-making based on empirical evidence.

Demographic Information of the Respondents

Figure 1

Gender Distribution



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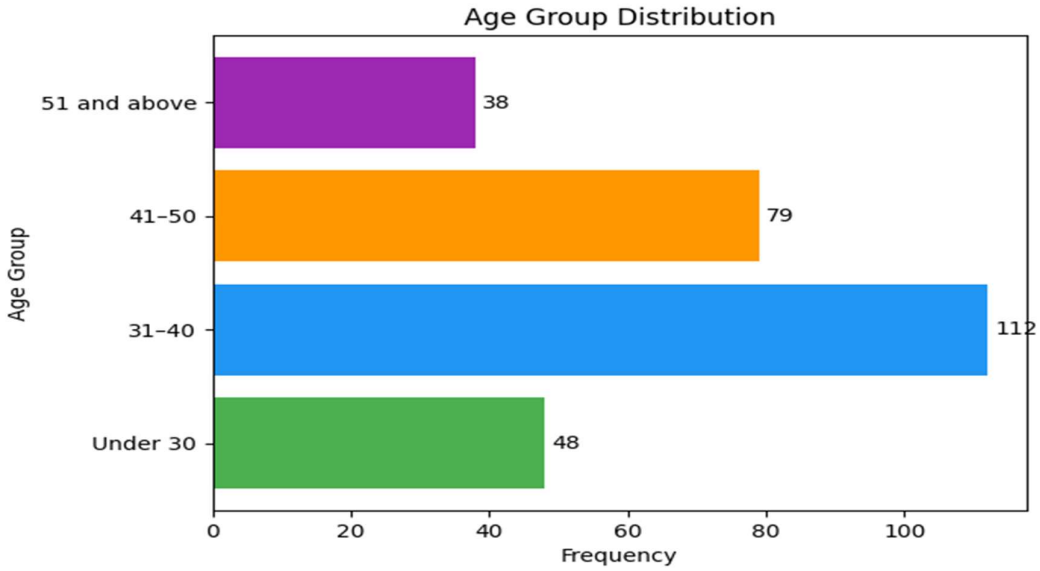
As shown in ***Figure 1***, the gender distribution of the respondents indicates that the majority were male, comprising 168 participants (60.6%), while 109 participants (39.4%) were female. This demonstrates that male respondents represented a larger proportion of the sample compared to female respondents. Overall, the study sample consisted of 277 participants, with males forming the dominant group in the dataset.

Age Group Distribution

Figure 2

Age Distribution

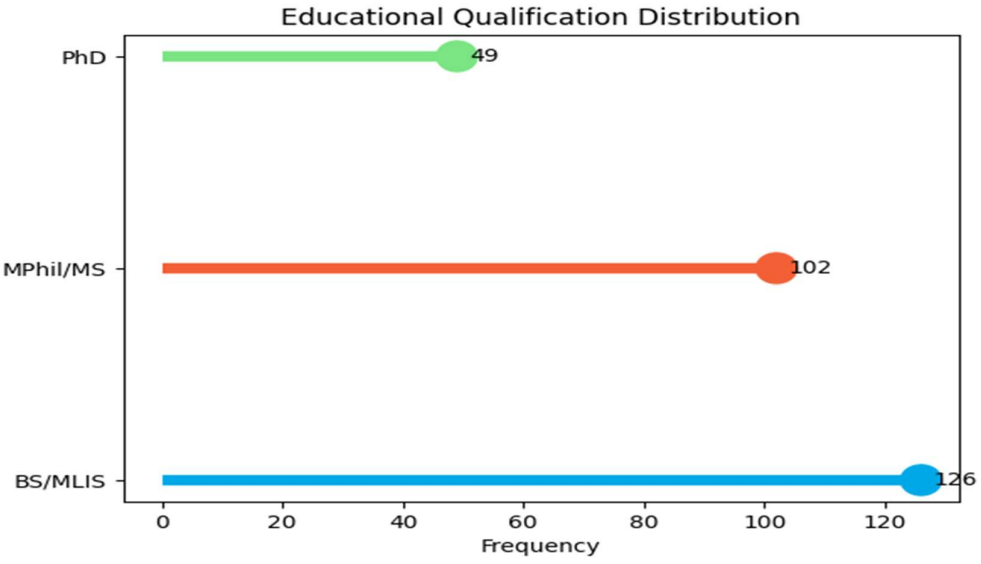


As illustrated in ***Figure 2***, the age distribution of respondents shows that the largest group falls within the 31–40 years category, comprising 112 participants (40.4%). This is followed by respondents aged 41–50 years, with 79 participants (28.5%). Participants under 30 years account for 48 respondents (17.3%), while those 51 years and above represent the smallest group, with 38 participants (13.7%). In total, the study included 277 respondents, with the majority concentrated in the 31–40 years age group.

Educational Qualification Distribution

Figure 3

Educational Qualification



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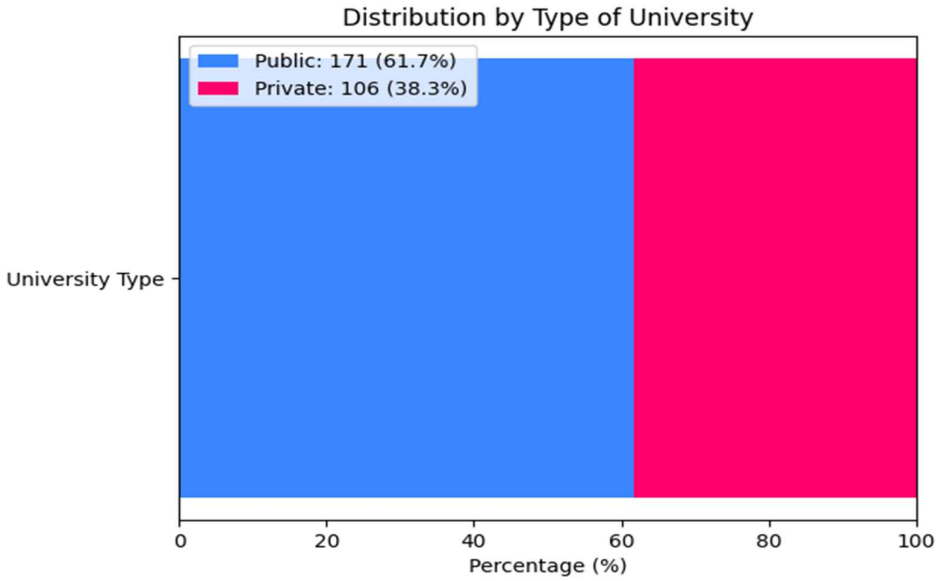
As presented in ***Figure 3***, the educational qualifications of the respondents show that the largest proportion holds a BS/MLIS degree, accounting for 126 participants (45.5%). This is followed by respondents with an MPhil/MS degree, comprising 102 participants (36.8%). A smaller segment of the sample holds a PhD, with 49 participants (17.7%). Overall, the findings indicate that the majority of respondents possess BS/MLIS qualifications, while a comparatively smaller proportion has attained doctoral-level education.

Type of the University Wise Distribution

Figure 4

University Type distribution

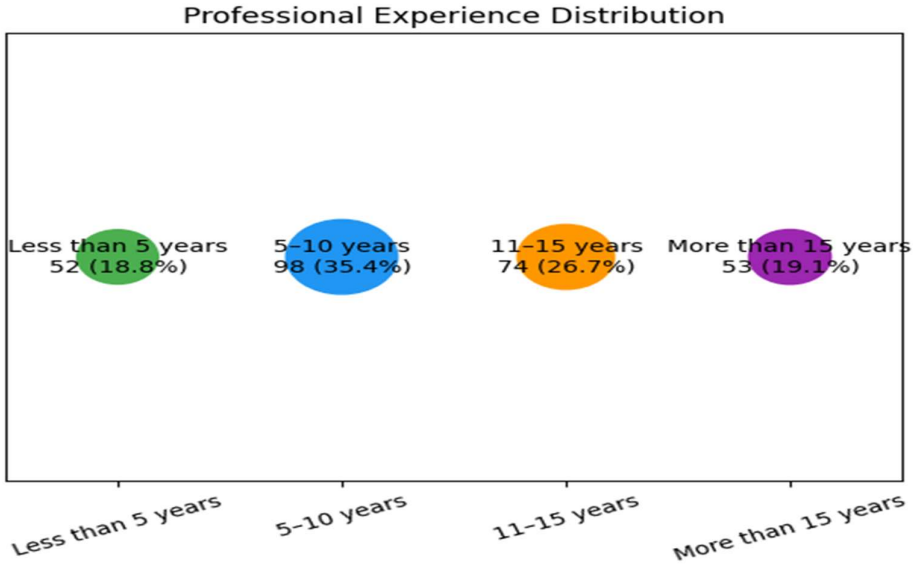


As illustrated in ***Figure 4***, the distribution of respondents by type of university indicates that the majority are affiliated with public universities, accounting for 171 participants (61.7%). In contrast, 106 respondents (38.3%) belong to private universities. Out of the total 277 participants, a larger proportion is associated with the public sector, suggesting stronger representation from public universities in the sample.

Professional Experience wise distribution

Figure 5

Professional Experience Distribution



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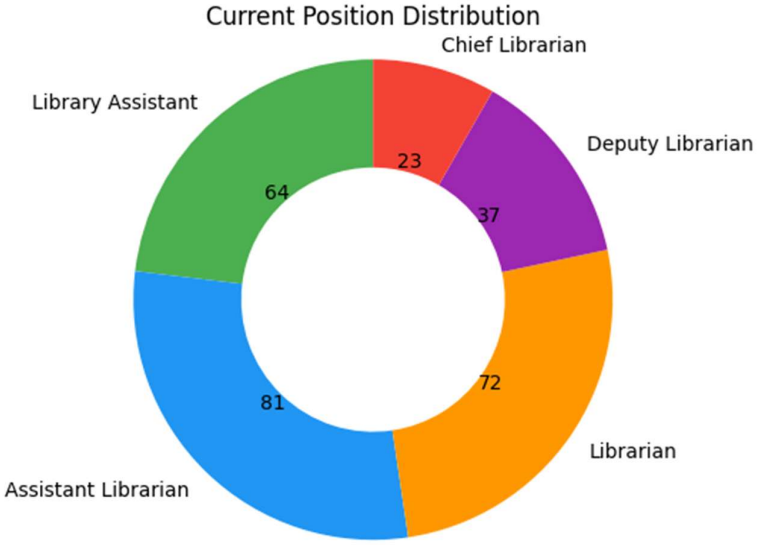
As shown in ***Figure 5***, the distribution of respondents based on professional experience reveals that the largest group has 5–10 years of experience, comprising 98 participants (35.4%). This is followed by respondents with 11–15 years of experience, accounting for 74 participants (26.7%). Participants with more than 15 years of experience represent 53 respondents (19.1%), while 52 respondents (18.8%) have less than 5 years of professional experience. Overall, the findings indicate that most respondents possess moderate professional experience, particularly within the 5–10 year range.

Current Position of the Respondents

Figure 6

Current Position of the Respondents



As presented in ***Figure 6***, the distribution of respondents by current position indicates that the largest group consists of Assistant Librarians, with 81 participants (29.2%). This is followed by Librarians, accounting for 72 respondents (26.0%), and Library Assistants, with 64 respondents (23.1%). A smaller proportion of participants hold the position of Deputy Librarian, representing 37 respondents (13.4%), while Chief Librarians form the smallest group with 23 respondents (8.3%). Overall, the data shows that the majority of respondents occupy mid-level professional positions within the library hierarchy.

Awareness and Knowledge of AI

As presented in **Table 1**, the findings indicate a generally positive level of awareness and knowledge regarding Artificial Intelligence (AI) among the respondents. A substantial proportion of participants reported being familiar with the concept of AI, with 47.7% agreeing and 23.1% strongly agreeing, while a relatively small percentage expressed disagreement.

Similarly, regarding the understanding of AI applications, 43.7% of respondents agreed and 20.2% strongly agreed, indicating that a considerable number of participants possess knowledge of how AI can be applied in professional contexts. However, responses concerning institutional provision of AI training were less favorable. A noticeable proportion of respondents reported disagreement, with 24.9% disagreeing and 17.3% strongly disagreeing, suggesting that many institutions may not yet be providing sufficient AI-related training opportunities.

In terms of regularly updating knowledge about AI, most respondents showed a positive tendency, with 39.7% agreeing and 19.5% strongly agreeing, reflecting an effort among professionals to stay informed about emerging technologies. Furthermore, a strong consensus emerged regarding the relevance of AI to modern libraries, where 51.6% agreed and 28.5% strongly agreed, indicating widespread recognition of the importance of AI in contemporary library services and operations. Overall, the results suggest a high level of awareness about AI and its relevance, although institutional training support appears comparatively limited.

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Table 1

Awareness & Knowledge of AI

Item	SD	D	N	A	SA
Familiar with AI concept	12 (4.3%)	28 (10.1%)	41 (14.8%)	132 (47.7%)	64 (23.1%)
Understand AI applications	15 (5.4%)	33 (11.9%)	52 (18.8%)	121 (43.7%)	56 (20.2%)
Institution provides AI training	48 (17.3%)	69 (24.9%)	71 (25.6%)	63 (22.7%)	26 (9.4%)
Update knowledge regularly	18 (6.5%)	35 (12.6%)	60 (21.7%)	110 (39.7%)	54 (19.5%)
AI relevant to modern libraries	9 (3.2%)	17 (6.1%)	29 (10.5%)	143 (51.6%)	79 (28.5%)

(Scale: 1=SD, 2=D, 3=N, 4=A, 5=SA)

AI Applications in Library Services

As presented in **Table 2**, the responses indicate a strong positive perception of AI applications in library services. A majority of respondents agreed that AI improves cataloguing, with 50.2% agreeing and 20.6% strongly agreeing, while only a small proportion expressed disagreement.

Similarly, most participants acknowledged that AI enhances information retrieval efficiency, with 53.1% agreeing and 24.2% strongly agreeing, indicating a high level of confidence in AI-driven retrieval systems. Regarding AI-powered chatbots for user support, 39.0% agreed and 15.2% strongly agreed, although a noticeable portion of respondents remained neutral (24.9%), suggesting moderate acceptance of this application.

The results also show positive perceptions toward AI-based recommendation systems for research, where 46.2% agreed and 19.9% strongly agreed that such systems assist users in identifying relevant resources. In addition, automated indexing was widely viewed as beneficial, with 51.3% agreeing and 24.2% strongly agreeing that it saves time in information organization.

Furthermore, respondents strongly supported the role of AI in plagiarism detection, with 53.8% agreeing and 24.9% strongly agreeing, highlighting its perceived importance in maintaining academic integrity. Likewise, the majority believed that AI enhances digital library services, as reflected by 52.7% agreeing and 27.1% strongly agreeing. Overall, the findings demonstrate a clear consensus among respondents that AI technologies significantly contribute to improving various aspects of modern library services.

Table 2

AI Applications in Library Services

Item	SD	D	N	A	SA
AI improves cataloguing	11 (4.0%)	22 (7.9%)	48 (17.3%)	139 (50.2%)	57 (20.6%)
Enhances retrieval efficiency	8 (2.9%)	19 (6.9%)	36 (13.0%)	147 (53.1%)	67 (24.2%)
Chatbots improve support	21 (7.6%)	37 (13.4%)	69 (24.9%)	108 (39.0%)	42 (15.2%)
Recommendation systems help research	14 (5.1%)	25 (9.0%)	55 (19.9%)	128 (46.2%)	55 (19.9%)
Automated indexing saves time	10 (3.6%)	18 (6.5%)	40 (14.4%)	142 (51.3%)	67 (24.2%)
AI supports plagiarism detection	6 (2.2%)	15 (5.4%)	38 (13.7%)	149 (53.8%)	69 (24.9%)
Enhances digital library services	7 (2.5%)	16 (5.8%)	33 (11.9%)	146 (52.7%)	75 (27.1%)

(Scale: 1=SD, 2=D, 3=N, 4=A, 5=SA)

AI and Quality Education

As presented in **Table 3**, the findings indicate that respondents generally hold a positive perception of the role of Artificial Intelligence (AI) in promoting quality education. A majority agreed that AI improves learning outcomes, with 52.7% agreeing and 22.4% strongly agreeing, while only a small proportion expressed disagreement.

Similarly, respondents acknowledged that AI supports personalized learning, as 47.7% agreed and 18.1% strongly agreed, although 20.9% remained neutral, suggesting moderate awareness of its role in tailored learning experiences.

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The strongest agreement was observed regarding the statement that AI assists researchers, where 54.9% agreed and 26.7% strongly agreed, indicating widespread recognition of AI tools in supporting research activities.

Participants also expressed positive views about AI enhancing accessibility in education, with 50.9% agreeing and 21.3% strongly agreeing, suggesting that AI can help make educational resources more accessible to diverse users.

Regarding the contribution of AI to Sustainable Development Goal 4 (Quality Education), 42.6% agreed and 17.7% strongly agreed, although 24.2% remained neutral, indicating some uncertainty about its broader policy-level impact.

Finally, the majority of respondents believed that AI improves academic productivity, with 53.8% agreeing and 24.5% strongly agreeing. Overall, the results highlight a strong consensus that AI plays a significant role in enhancing learning, research, accessibility, and productivity within the educational environment.

Table 3

AI & Quality Education

Item	SD	D	N	A	SA
Improves learning outcomes	9 (3.2%)	18 (6.5%)	42 (15.2%)	146 (52.7%)	62 (22.4%)
Supports personalized learning	13 (4.7%)	24 (8.7%)	58 (20.9%)	132 (47.7%)	50 (18.1%)
Assists researchers	6 (2.2%)	14 (5.1%)	31 (11.2%)	152 (54.9%)	74 (26.7%)
Enhances accessibility	11 (4.0%)	20 (7.2%)	46 (16.6%)	141 (50.9%)	59 (21.3%)
Contributes to SDG 4	15 (5.4%)	28 10.1%)	67 (24.2%)	118 (42.6%)	49 (17.7%)
Improves academic productivity	8 (2.9%)	17 (6.1%)	35 (12.6%)	149 (53.8%)	68 (24.5%)

(Scale: 1=SD, 2=D, 3=N, 4=A, 5=SA)

Institutional Readiness & Infrastructure

As presented in **Table 4**, the responses reveal mixed perceptions regarding institutional readiness and infrastructure for the adoption of Artificial Intelligence (AI) in libraries. Concerning the availability of adequate IT infrastructure, a considerable proportion of respondents expressed disagreement, with 26.4% disagreeing and 14.8% strongly disagreeing, while 24.9% agreed and 9.0% strongly agreed, indicating that many institutions may lack sufficient technological infrastructure.

In terms of administrative support, responses were relatively more positive, as 31.8% of respondents agreed and 13.7% strongly agreed that their institutions provide administrative backing for AI initiatives. However, 26.7% remained neutral, suggesting that support may vary across institutions.

The results show significant concern regarding the availability of sufficient budget for AI implementation. A large proportion of respondents reported disagreement, with 32.1% disagreeing and 22.4% strongly disagreeing, indicating financial constraints as a major barrier to adopting AI technologies in libraries.

Regarding staff readiness for AI adoption, 36.5% of respondents agreed and 13.4% strongly agreed, suggesting that many professionals feel prepared to engage with AI technologies, although 26.0% remained neutral.

Finally, the presence of a clear AI policy within institutions appears limited. A significant proportion of respondents reported disagreement, with 29.6% disagreeing and 19.9% strongly disagreeing, while only 17.7% agreed and 6.5% strongly agreed, indicating that formal AI-related policies are still lacking in many institutions. Overall, the findings suggest that while staff readiness and administrative support show some positive trends, challenges related to infrastructure, budget, and policy remain key obstacles to AI implementation.

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Table 4

Institutional Readiness & Infrastructure

Item	SD	D	N	A	SA
Adequate IT infrastructure	41 (14.8%)	73 (26.4%)	69 (24.9%)	69 (24.9%)	25 (9.0%)
Administrative support	28 (10.1%)	49 (17.7%)	74 (26.7%)	88 (31.8%)	38 (13.7%)
Sufficient budget	62 (22.4%)	89 (32.1%)	63 (22.7%)	46 (16.6%)	17 (6.1%)
Staff readiness	23 (8.3%)	44 (15.9%)	72 (26.0%)	101 (36.5%)	37 (13.4%)
Clear AI policy	55 (19.9%)	82 (29.6%)	73 (26.4%)	49 (17.7%)	18 (6.5%)

(Scale: 1=SD, 2=D, 3=N, 4=A, 5=SA)

Challenges of AI Implementation

As presented in **Table 5**, the results highlight several significant challenges associated with the implementation of Artificial Intelligence (AI) in library services. A majority of respondents identified the lack of technical expertise as a major challenge, with 53.4% agreeing and 22.4% strongly agreeing, indicating that many institutions may not have adequately trained personnel to manage AI technologies.

Similarly, high implementation cost emerged as one of the most prominent barriers. A large proportion of respondents acknowledged this issue, with 53.8% agreeing and 28.9% strongly agreeing, suggesting that financial constraints significantly hinder the adoption of AI systems.

Concerns related to data privacy were also widely recognized, as 49.1% of respondents agreed and 23.1% strongly agreed that privacy and data protection issues pose challenges when implementing AI-based solutions.

In addition, resistance to change among staff members was identified as another obstacle. 41.9% of respondents agreed and 15.9% strongly agreed that organizational resistance can slow down the integration of AI technologies in library operations.

Finally, insufficient training opportunities were also highlighted as a challenge, with 50.5% agreeing and 20.2% strongly agreeing, indicating that many professionals feel that existing training programs are inadequate for effectively adopting AI tools. Overall, the findings demonstrate that although AI offers significant benefits, challenges such as limited expertise, financial constraints, privacy concerns, resistance to change, and insufficient training remain major barriers to its successful implementation.

Table 5

Challenges of AI Implementation

Item	SD	D	N	A	SA
Lack of technical expertise	9 (3.2%)	19 (6.9%)	39 (14.1%)	148 (53.4%)	62 (22.4%)
High implementation cost	6 (2.2%)	14 (5.1%)	28 (10.1%)	149 (53.8%)	80 (28.9%)
Data privacy concerns	12 (4.3%)	21 (7.6%)	44 (15.9%)	136 (49.1%)	64 (23.1%)
Resistance to change	18 (6.5%)	36 (13.0%)	63 (22.7%)	116 (41.9%)	44 (15.9%)
Insufficient training	11 (4.0%)	22 (7.9%)	48 (17.3%)	140 (50.5%)	56 (20.2%)

(Scale: 1=SD, 2=D, 3=N, 4=A, 5=SA)

Future Prospects & Recommendations

As presented in Table 6, the findings indicate a strong positive outlook regarding the future prospects of Artificial Intelligence (AI) in library services. A large majority of respondents believe that AI will become essential in libraries within the next five years, with 53.8% agreeing and 28.9% strongly agreeing, while only a small proportion expressed disagreement.

Similarly, there is overwhelming support for continuous AI training for library professionals, as 54.5% of respondents agreed and 34.3% strongly agreed, highlighting the importance of ongoing skill development to effectively utilize AI technologies.

Respondents also emphasized the need for collaboration with IT professionals, with 57.0% agreeing

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and 33.6% strongly agreeing, indicating that interdisciplinary cooperation is considered crucial for successful AI integration.

Furthermore, many participants believe that AI will redefine the role of librarians in the future, as reflected by 51.3% agreeing and 26.0% strongly agreeing, suggesting that AI is expected to significantly influence professional responsibilities and service delivery.

Finally, regarding plans to expand AI services in libraries, 37.2% of respondents agreed and 15.5% strongly agreed, while 26.7% remained neutral, indicating a generally positive but somewhat cautious approach toward future AI expansion. Overall, the results suggest that respondents hold an optimistic view of AI adoption, emphasizing training, collaboration, and strategic planning as key factors for its successful implementation in libraries.

Table 6

Future Prospects & Recommendations

Item	SD	D	N	A	SA
AI essential within 5 years	5 (1.8%)	11 (4.0%)	32 (11.6%)	149 (53.8%)	80 (28.9%)
Continuous AI training necessary	4 (1.4%)	8 (2.9%)	19 (6.9%)	151 (54.5%)	95 (34.3%)
Collaboration with IT crucial	3 (1.1%)	7 (2.5%)	16 (5.8%)	158 (57.0%)	93 (33.6%)
AI will redefine librarian role	7 (2.5%)	15 (5.4%)	41 (14.8%)	142 (51.3%)	72 (26.0%)
Plans to expand AI services	18 (6.5%)	39 (14.1%)	74 (26.7%)	103 (37.2%)	43 (15.5%)

(Scale: 1=SD, 2=D, 3=N, 4=A, 5=SA)

5. Discussion

The findings of this study provide important insights into the growing role of Artificial Intelligence (AI) in university library services and its potential contribution to quality education. The results indicate that most library professionals possess a considerable level of awareness regarding AI concepts and applications. This aligns with earlier studies suggesting that librarians increasingly recognize the relevance of intelligent technologies in modern information environments (Jha, 2023; Panda & Chakravarty, 2022). The strong agreement among respondents that AI is relevant to contemporary libraries suggests that professionals understand the strategic importance of technological innovation in improving service efficiency and user satisfaction. However, the limited institutional provision of AI training indicates a gap between awareness and practical capacity, which has also been highlighted in previous research on AI adoption in developing countries (Ayeni et al., 2024; Yang, 2021).

The findings further demonstrate that AI applications such as automated cataloguing, intelligent retrieval systems, recommendation engines, and plagiarism detection are widely perceived as beneficial for improving library operations. These perceptions support the arguments of Asemi et al. (2021) and Yusuf et al. (2022), who emphasized that AI technologies enhance information organization, retrieval accuracy, and service responsiveness in academic libraries. In addition, respondents strongly agreed that AI contributes to improved research support and academic productivity. This confirms earlier studies suggesting that AI-powered tools can facilitate personalized learning, assist researchers in discovering relevant literature, and promote inclusive access to information resources (Harry & Sayudin, 2023; Susanti et al., 2025). Therefore, AI-enabled library systems can be viewed as important enablers of quality education within higher education institutions.

Despite these positive perceptions, the study also identifies significant institutional and operational barriers to AI adoption. Many respondents reported inadequate technological infrastructure, insufficient budgets, and the absence of clear AI policies within their institutions. These challenges are consistent with the findings of Zhai et al. (2021) and Tait and Pierson (2022), who noted that financial limitations, policy gaps, and limited technical expertise often hinder the implementation of advanced technologies in academic libraries. Furthermore, issues such as data privacy concerns and resistance to organizational change indicate that successful AI integration requires not only technological investment but also cultural and administrative support.

Overall, the results suggest that while Pakistani university libraries demonstrate strong professional

awareness and positive attitudes toward AI, effective implementation depends on strategic planning, infrastructure development, and continuous professional training. Strengthening collaboration between library professionals and IT departments may play a crucial role in facilitating sustainable AI integration and supporting the transformation of academic library services in the digital era.

6. Limitations of the Study

This study has several limitations that should be acknowledged when interpreting the findings. First, the research was conducted using a quantitative survey method, which primarily captures respondents' perceptions and opinions rather than providing deeper qualitative insights into the practical implementation of Artificial Intelligence in library environments. Second, the study used a convenience sampling technique, which may limit the generalizability of the findings to all university libraries in Pakistan. Although 277 library professionals participated, the sample may not fully represent the diversity of institutional contexts across the country. Third, the data were collected through self-reported responses, which may involve personal bias or subjective interpretation of AI-related knowledge and practices. Finally, the study relied mainly on descriptive statistical analysis, which limits the ability to examine causal relationships or deeper statistical associations between variables related to AI adoption in library services.

7. Future Research Directions

Future studies can expand the scope of this research in several ways. First, researchers may adopt mixed-method or qualitative approaches, such as interviews or case studies, to gain deeper insights into how Artificial Intelligence technologies are practically implemented within academic libraries and how librarians interact with these systems in their daily professional activities. Such approaches could provide a more comprehensive understanding of the organizational and technical dynamics involved in AI adoption.

Second, future research may include a larger and more diverse sample from different regions and types of higher education institutions to improve the generalizability of findings. Comparative studies between public and private universities, or between developed and developing countries, may also provide valuable insights into differences in technological readiness and AI integration strategies.

Third, further studies may apply advanced statistical techniques, such as regression analysis or structural equation modeling, to examine the relationships between variables such as institutional readiness, professional competencies, and AI adoption outcomes. Finally, future research may focus on specific AI applications in libraries, including chatbots, recommendation systems, automated cataloguing, and intelligent information retrieval systems, in order to evaluate their effectiveness in improving user experience, research productivity, and quality education outcomes.

8. Conclusion and Recommendations

This study examined the awareness, applications, institutional readiness, challenges, and future prospects of Artificial Intelligence (AI) in university library services in Pakistan. The findings indicate that library professionals generally possess a positive level of awareness and understanding regarding AI technologies and their relevance to modern library operations. Respondents widely recognized the potential of AI applications such as automated cataloguing, intelligent information retrieval systems, recommendation tools, plagiarism detection software, and chatbots in enhancing the efficiency and effectiveness of library services. The results further suggest that AI integration contributes significantly to supporting research activities, improving academic productivity, and promoting inclusive and personalized learning environments, thereby strengthening the role of libraries in advancing quality education within higher education institutions.

Despite these positive perceptions, the study also reveals several structural and organizational barriers that limit the effective implementation of AI in university libraries. Many institutions face constraints related to inadequate technological infrastructure, limited financial resources, absence of clear AI-related policies, and insufficient professional training opportunities. In addition, concerns regarding data privacy and resistance to technological change among staff members continue to hinder the adoption of intelligent systems. These challenges highlight the need for a more strategic and coordinated approach to technological innovation in academic libraries.

Based on these findings, several recommendations emerge for improving AI adoption in university libraries. First, universities should invest in modern technological infrastructure and allocate sufficient

financial resources to support the development and maintenance of AI-based library systems. Second, continuous professional development programs and specialized training workshops should be organized to enhance librarians' technical competencies and confidence in using AI tools. Third, institutional policies and strategic frameworks should be developed to guide the ethical and effective implementation of AI technologies in library environments. Fourth, stronger collaboration between library professionals and information technology departments should be encouraged to ensure smooth integration, maintenance, and innovation of digital services. Finally, academic institutions should promote research and pilot projects related to AI applications in libraries to explore innovative service models and improve evidence-based decision-making.

Overall, the integration of Artificial Intelligence has the potential to transform university libraries into intelligent knowledge hubs that support advanced research, personalized learning, and efficient information services. With appropriate investment, policy support, and professional capacity building, AI can play a significant role in shaping the future of academic libraries and strengthening their contribution to quality education.

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Contribution of Authors

All the authors participated in the ideation, development, and final approval of the manuscript, making significant contributions to the work reported.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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Informed Consent

Informed consent was obtained from all individual participants included in the study.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of 1964 Helsinki declaration and its later amendments.

Data Availability

The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

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