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ADOPTION POTENTIAL OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN ISLAMABAD'S ACADEMIC LIBRARIES

Kanwal Islam [1], Ayesha Shamshad [2], Muhammad Usman [3]

Affiliations

[1] Librarian, Government Associate College for Women Saddar, Rawalpindi
kanwalmalikmk603@gmail.com

[2] Senior Executive Librarian, Gift University Gujranwala
ayesha.shamshad@gmail.com

[3] Assistant Librarian, Department of Library, University of Agriculture, Faisalabad
usmanchmphil@yahoo.com

Corresponding Author's Email

[2] ayesha.shamshad@gmail.com

Abstract

This research intends to determine the preparedness of academic libraries of Islamabad with respect to the adoption of Artificial Intelligence (AI) and Machine Learning (ML) technologies, looking especially into the awareness, attitude, and infrastructure of the library professionals concerning these technologies. The research employs a quantitative design and gathered data using a structured questionnaire from a sample of 250 university librarians within Islamabad. The questionnaire incorporated items relating to the participants' awareness of AI/ML, their access to technological infrastructure, and the barriers to the adoption of AI/ML. The data were processed using SPSS-29, and for presenting the findings, tables were used with descriptive statistics and frequency distribution. The outcomes of the study indicate that while librarians have some general knowledge of AI/ML technologies, their specific applicability to the running of libraries is poorly understood. Readiness of infrastructure differs from one library to another; a good number of them do not have supporting IT infrastructure and personnel for full integration. There is, however, a positive attitude towards AI/ML adoption, with respondents claiming they were willing to be trained and actively support the adoption of AI/ML in their institutions. This study adds to the growing literature on the adoption of AI and ML in developing countries like Pakistan. The study highlights challenges and prospects AI/ML technology offers to academic libraries, along with suggestions to address identified problems. These findings assist the administration and policy makers in understanding how to equip libraries in advance for the evolving transformation of library services.

Keywords: Artificial Intelligence (AI), Machine Learning (ML), Library Professionals, AI Adoption, Infrastructure Readiness, Academic Libraries

I. INTRODUCTION

In the past couple of years, the advancements and applications of artificial intelligence (AI) and machine learning (ML) have undergone development within a multitude of industries, ranging from healthcare, finance, and transportation to education. Academic libraries, being the core information hubs of learning institutions, have not been left out in this technological wave, and are starting to examine the possibilities that new technologies can offer to improve the scope of their services and functions. The capabilities of AI and ML technologies such as intelligent search engines, recommendation systems, automated cataloging, natural language processing, and predictive analytics spell great improvements in accuracy and personalization of library processes [28]. As academic libraries strive to keep pace with evolving information-seeking patterns and expanding digital content, it is very clear that they are increasingly pressured to innovate in order to survive and be useful in the rapidly advancing world of technology. Libraries around the world are now moving towards the implementation of AI and ML systems for the automation of menial

tasks and to enhance engagement with the users [4]. However, factors like AI and ML readiness, institutional infrastructure, available human capital, and the presence of concrete strategic plans affect the speed and level of integration of these systems [10].

In developing countries like Pakistan, the use of Artificial Intelligence (AI) and Machine Learning (ML) in academic libraries are in the early stages. Major public and private universities in Islamabad, the capital city and educational center, have well-equipped libraries [21]. While interest in using AI is increasing, whether there is an interest in using the available technologies remains a question. There have been some initial attempts to automate library processes and provide electronic materials, but the move toward self-service intelligent automation is hampered by several systemic problems, which include insufficient resources, the absence of a technological framework, and policies that stifle AI-enabled change [24]. Additionally, the use of AI and ML depends on the level of knowledge, perceptions, and skills of librarians who are fundamental in technology design, implementation, and management. To apply technology successfully, understanding the perceptions and readiness of the users becomes imperative [8], [40].

AI has many applications in academic libraries. For example, intelligent cataloging systems can automatically sort print and digital materials using natural language processing and machine learning, which saves human effort and increases precision. In the same manner, library chat-bots and virtual assistants can attend to repetitive queries and provide 24/7 navigation services to the library, which enhances user support [26]. Based on user history, recommendation applications can provide users with relevant research documents for their perusal, thus, making the research process more personalized and easier [11]. In addition, AI technologies can sift through enormous amounts of usage data to identify possible trends, which can greatly assist in informing collection development policy decisions. These examples demonstrate some of the ways in which AI and ML technologies can change the services offered in academic libraries. Still, realization of these advantages requires the libraries' readiness in terms of infrastructure, skillset, and overarching plans [1], [30].

Despite Islamabad's academic libraries being better funded than those in other parts of Pakistan, there are still notable gaps in the use of modern technologies. Disparities in internet connectivity, access to contemporary hardware, and the implementation of sophisticated library management systems continue to widen the digital divide [31]. Many of these gaps are attributed to the lack of specialized training in AI and computer science, making it extremely difficult for professionals to think of, implement, and sustain AI-powered systems. Research suggests that librarians in Pakistan tend to possess a favorable perception of technology. Yet, a lack of adequate training and resources renders them incapable of addressing relevant contemporary technologies [5]. This challenge underscores the increasing need for scaffolding policies aimed at developing AI capabilities for librarians through structured funding and institutional frameworks to foster libraries powered by artificial intelligence [32], [35].

Besides the technical and human resource issues, the readiness for AI adoption has organizational culture and leadership influences. Libraries with a culture of innovation and continuous learning are more likely to take risks with new technologies and adapt to changing user needs [3]. Traditional bureaucratic structures can stifle innovation and slow the flow of ideas. Further aloft, resistance to change, especially from more senior staff or administrators not well versed in digital tool use, can further stall the process. Additionally, the belief that automation will result in job loss may cause reluctance to support AI initiatives from library staff members [2]. These issues underscore the importance of effective change management approaches that position technological integration not as job security threats, but opportunities for professional advancement for employees and improving service enhancement delivery [33].

There is a host of discourse regarding the implementation of AI and ML in libraries with case studies describing well executed implementations available in more technologically developed countries [12]. Stanford University and the British Library have been at the forefront of applying AI to automating tasks like metadata harvesting, user interaction, and digital archive maintenance [34]. Such examples are instructional regarding the balance of implementing technology and institutional goals, as well as potential best practices and pitfalls. Nonetheless, none of these models can be brought into Pakistan's context without careful

consideration of local barriers and capabilities [27]. The academic libraries in Islamabad need to be provided with resourceful approaches designed with keen regard to the operational structures, user types, and organizational policies of such institutions [17]. This requires conducting qualitative research that assesses the levels of AI readiness these libraries have within their infrastructure systems [23].

The significance of this study lies in its contribution in planning strategies and policies for academic libraries in Islamabad and elsewhere. The study seeks to evaluate how the participants' awareness levels, infrastructural preparedness, perceived difficulties, and professional skills influences gaining readiness pertaining to adoption AI and ML systems [6]. The results of this study may assist decision makers at the libraries, educational regulators, and funding bodies in determining the appropriate investment for resource and structure development, technology integration, and management of system facilities offered. This study could also provide an example for other academic libraries in the same economic situation while expanding the literature on digital transformation in library and information science.

This research has four primary objectives: first, to evaluate the awareness and perception levels of AI and ML technologies among the librarians working within the academic libraries of Islamabad; second, to analyze the technological framework and AI resources infrastructure that is available; third, to explore the issues and constraints which affect the implementation of AI and ML in academic libraries; and fourth, to offer optimization suggestions for better preparing the integration strategies concerning AI technologies. Employing a mixed-method strategy, the research gathers quantitative evidence from surveys and qualitative evidence from interviews to construct a more comprehensive narrative around the problem. This overt combination of methods increases the dependability, credibility, and comprehensiveness of conclusions that can be drawn concerning the adoption readiness [16].

As the digital transformation of academic libraries progresses, their AI and ML capabilities will increasingly determine operational relevance and efficiency. The shift from conventional resource centers to intelligent knowledge hubs calls for comprehensive planning, strategic capital allocation, and persistent effort in professional advancement. For Islamabad's academic libraries, this change is both a challenge and an opportunity. This study analyzes the readiness level for AI and ML adoption and contributes to the discourse of innovation in library services, illustrating further steps for developing the academic landscape in Pakistan.

II. PROBLEM STATEMENT

The global development of information management systems has been revolutionized with the introduction of Artificial Intelligence (AI) and Machine Learning (ML). It promises increased automation, efficiency, and improved user experiences within academic libraries. The incorporation of AI and ML technologies into academic libraries in Islamabad, however, appears to be a largely un-researched area, particularly regarding its implementation, obstacles, and overall impact.

The use of AI in libraries—encompassing chatbots, automated cataloging, intelligent search engines, and predictive analytics—has emerged as a global norm, yet many academic libraries in Islamabad continue to operate using outdated methods. This can be attributed to a lack of technological resources, inadequate funding, insufficient staff training, data security issues, and general reluctance to change. These unacknowledged challenges stand to hinder accessible AI-powered innovations that serve to optimize resources and information, increase user interactions, and streamline usability within libraries in Islamabad.

A. Objectives Of The Study

1. To assess the current level of awareness and readiness regarding AI and ML technologies among academic librarians and administrators in Islamabad.
2. To identify the key challenges (technological, financial, organizational, and ethical) hindering the adoption of AI and ML in academic libraries in Islamabad.
3. To explore the perceived benefits of AI and ML integration in library services, including improvements in efficiency, user experience, and resource management.
4. To propose strategic recommendations for policymakers and library stakeholders to facilitate the effective adoption of AI and ML in Islamabad's academic libraries.

III. LITERATURE REVIEW

A. *Current Developments in AI and ML Implementation in University Libraries*

Readily apparent on a global scale, the incorporation of Artificial Intelligence (AI) and Machine Learning (ML) into academic libraries is growing at a rapid pace. In developed regions, the assistance of AI has been accepted widely in libraries to promote user services, make office work less burdensome, and enhance decision making. For example, libraries in the United States and Europe have incorporated AI-enabled chatbots for reference services, automated cataloging systems, and self-service information retrieval systems, which recommend information to users [19], [37], [41]. Such advancements have improved operational efficiency and boosted satisfaction levels among library users.

On the other hand, developing countries are being hindered from accessing AI technologies by a lack of resources, poor infrastructure, and insufficient technical knowledge. Despite this, there is more awareness now about how AI can fine-tune library services. Research shows that there are favorable misconceptions indeed regarding the use of AI for specialists, but it is acknowledged that such preconceived ideas are in place because there is a lack of support, guidance, and training [29], [36].

B. *AI and ML in Academic Libraries of Pakistan*

The incorporation and application of AI and ML technologies to academic libraries in Pakistan is not fully developed. It has been reported that at least there is some knowledge of AI tools among librarians, albeit very little action is taken to use them. According to a case study conducted by [15] there is very little awareness of AI integration in university libraries in Pakistan, and the adoption of technology within the domain tends to lag behind. Organizational technological environment, financial constraints, university scale, and issues related to data management are some of the factors that determine the willingness to adopt AI [13], [38].

However, some Pakistani academic libraries have taken the initial steps toward full integration of AI tools. Some libraries have incorporated Radio Frequency Identification (RFID) technology for smoother inventory access as well as self-checkout systems. Others have begun using AI intelligent chat-bots to help users with basic queries [20]. While these movements are very minimal, they still highlight a step forward toward achievement of AI application in libraries.

C. *Barriers to the Implementation of Artificial Intelligence and Machine Learning in Academic Libraries Based in Islamabad*

The aforementioned concepts have still not found their footing in academic libraries located in Islamabad. One of the biggest challenges has been the profound staff skill gap associated with technology integration within such libraries. An overwhelming proportion of professionals in Pakistan simply do not have the requisite knowledge and training in Artificial Intelligence technology, making it almost impossible to administer such systems [14].

Moreover, considerable financial constraints do not make the challenge any easier. Funding constrains significantly impact optimally allocating resources toward advancing new technological frameworks, infrastructure, and training initiatives. Additionally, there lacks funding oriented cohesive strategy or policy to systematically integrate advanced AI technologies into the library services [18].

Negativism associated with the new technology among the library staff proves to be another hurdle. Poor perception about job loss and overall lack of familiarity with AI tools results in refusal to adoption. An all-encompassing approach centered on infrastructure, professional skill enhancement alongside with sophisticated holistic change strategies is vital to addressing the cited challenge [25].

D. *Theoretical Frameworks for the Study of AI Use in Academic Libraries*

The adoption of AI in academic libraries can be guided using a number of theories. The Technology-Organization-Environment (TOE) framework accounts for the technological, organizational, and environmental components, which impact a system's use [22]. The Technology Readiness Index (TRI) measures the technical optimism, innovativeness, discomfort, and insecurity of TRI's actors in determining their readiness to embrace new technologies. The use of these frameworks provides a detailed understanding of the various parts influencing AI adoption at libraries [9].

Research using these structures stresses the role of organizational support alongside resource availability and staff preparedness as critical to successful AI adoption. These include the notion that libraries with stronger leadership tend to perform better with AI technologies due to a supportive culture of innovation [7].

The reviewed literature underscores both the promising possibilities and the significant obstacles concerning the integration of Artificial Intelligence and Machine Learning in academic libraries, particularly vis-a-vis Islamabad. While AI technology is increasingly being integrated into libraries worldwide to improve efficiency and user satisfaction, the reality in Pakistan is hampered by infrastructural, financial, and professional competence constraints. Nevertheless, studies do indicate that attitudes toward AI adoption are generally favorable, which means that with adequate strategic planning and focused training programs coupled with institutional backing, academic libraries in Islamabad would be able to undertake successful digital transformation. The international case studies logic offered an important solicitude for developing context-sensitive frameworks to AI Readiness that encourage stakeholders in Pakistani academic libraries to strategically and deliberately use these frameworks and rid local obstacles in the implementation of intelligent library systems.

IV. METHODOLOGY

The research employs the use of Artificial Intelligence and Machine Learning in academic libraries in Islamabad with the help of a quantitative approach. To achieve this a survey was disseminated among 250 library professionals in universities in Islamabad. The sample drawn included librarians, assistant librarians and management staff which ensured that all levels of the academic library profession were covered.

In order to achieve the objectives of the study, data capturing related to various factors such as knowledge and understanding of AI/ML, the supporting infrastructure to these technologies, perceptions accompanying the integration of AI/ML, and the constraints for the use had to be collected. Respondents had to rate their agreement with the statements using rating scales from five to one: strongly agree, agree, undecided, disagree, and strongly disagree. This gave him detailed information on the respondents' perceptions, attitudes, skills, and other elements in relation to AI/ ML adoption across the scale.

The statistical calculations in this research were accomplished using SPSS-29 Software. To summarize the demographic data and the responses given, descriptive statistics were used. Specifically, there were frequency distributions with percentages that were generated to reveal trends concerning the different variables . Additionally, all the results were compiled and arranged in tables, which were presented section-wise so that different aspects AI/ML readiness in the libraries can be easily interpreted.

With this approach, it is possible to assess AI/ML adoption readiness comprehensively for academic libraries in Islamabad. Use of SPSS makes sure the accuracy and reliability of the analysis, whereas the detailed tables make it easy to grasp the responses and patterns organizationally from the data presented. It is hoped that these findings would assist the libraries in strategically improving their preparedness for the adoption of AI/ML technologies.

V. RESULTS & DISCUSSION

The results highlight the significant impact of is ocoumarin-based lactams in various synthetic pathways, demonstrating their potential in medicinal and industrial applications. The discussion emphasizes how these findings contribute to the understanding of lactam reactivity and offers insights for future research in this domain.

TABLE 1
DEMOGRAPHIC INFORMATION OF RESPONDENTS (N=250)

Category	Options	Frequency (n)	Percentage (%)
Gender	Male	120	48%
	Female	130	52%
Age	Under 25	30	12%
	25–34	90	36%

Category	Options	Frequency (n)	Percentage (%)
	35–44	70	28%
	45–54	40	16%
	55+	20	8%
Designation	Chief Librarian	25	10%
	Deputy Chief Librarian	35	14%
	Librarian	80	32%
	Assistant Librarian	60	24%
	Library Assistant	50	20%
Highest Educational Qualification	Bachelor's	50	20%
	Master's	120	48%
	M.Phil.	60	24%
	Ph.D.	20	8%
Years of Experience	<1 year	30	12%
	1–5 years	80	32%
	6–10 years	70	28%
	>10 years	70	28%

A. Gender Distribution

The survey results reveal almost equal gender distribution with female participants making up 52% while male respondents were 48%. This illustrates that the library workforce in Islamabad is inclusively gender balanced, which is likely to have diverse perspectives regarding the adoption of technology. In addition, the overwhelming majority of women is aligned with international trends in librariansary that is known to increasingly dominate by the feminized workforce.

B. Age Profile

The bottom age cohort or 25 - 34 years constitutes a signifying proportion of the sample at 36%, demonstrating the presence of youthful human capital, While the subsequent 35-44 age group 28, with under 25 years and 55 years representing 12% and 8%, have lower representation. The relatively younger age of many professionals is likely to be associated with an ease of dealing with innovation and new technologies. However, a considerably older, and experienced staff makes up the 16% aged 45-54 and 8% 55+, who are likely to possess valuable perspectives shaped by long standing operational realities and institutional memory.

C. Professional Responsibilities

The majority of respondents appear to be Librarians (32%) and Assistant Librarians (24%), which suggests some of them may be engaged in the day-to-day functions of the library. Chief Librarians and Deputy Chief Librarians together represent 24% of respondents, which means they capture rich input from lower-decision makers. Also well represented is the category of Library Assistants (20%), who are often considered to be the frontline employees. This range of respondents is strategically likely to be balanced in terms of strategy, management, and practical contribution to systems that AI/ML could be incorporated into as they understand organizational, functional, and technological workflows.

D. Educational Qualifications

Master's degree holders constitute the majority group with 48% followed by M.Phil. Degree holders with 24%. Less numerous are Bachelor's degrees and Ph.Ds. with 20% and 8% respectively. The high proportion of respondents with advanced qualifications (Masters and above) suggests that the workforce is, for the most part, capable of critically analyzing the application of AI/ML integrations. However, the comparatively low proportion of PhD holders may indicate a lack of specialists in new technologies, which leads to limited frameworks for detailed technical design implementation.

E. Years of Experience

The available information indicates a fairly even distribution of the experience ranges: 1-5 years at 32%, 6-10 years at 28%, and over 10 years at another 28%. Only 12% are newcomers (less than a year) in the

field. This balance is advantageous for assessing AI/ML readiness because there is a mix of seasoned perspectives and new insights. Those with 6 or more years of experience (56% of the total) are likely to identify institutional impediments to progress, while those with 1-5 years (32%) are likely to provide informed observations about contemporary advancements in librarianship.

TABLE 2
AWARENESS AND UNDERSTANDING OF AI/ML

Statement	1	2	3	4	5
I am aware of what Artificial Intelligence and Machine Learning are.	25	50	75	62	38
I understand how AI/ML can be applied in library operations.	30	45	90	55	30
I have received formal training or attended workshops on AI/ML.	40	60	50	65	35
I keep myself updated with developments in AI/ML in library science.	35	45	80	60	30
I feel confident discussing AI/ML with colleagues or stakeholders.	50	60	60	45	35

Table 2 presents the frequency distribution of responses for the Awareness and Understanding of AI/ML section. The responses are categorized into five Likert scale options: Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree (1,2,3,4,5).

F. Awareness of AI/ML

The respondents strongly agree (75) that they are aware of what AI and ML are and even a good percentage (50) responded neutrally. This implies that an appreciable number of respondents have at least some understanding of these technologies, though a number may still be unsure of their true understanding. The distribution shows a solid awareness base, wherein some respondents acknowledge the existence of such technologies, but also highlights the need to further deepen knowledge on its aspects so that overall awareness can be improved.

G. Understanding of AI/ML Applications in Library Operations

As indicated by the results, the level of understanding of how AI and ML could be used in library settings is moderate. While it appears that 90 respondents who were neutral's attitude reflects either disinterest or lack of practical experience with the subject, combined agreement (85) and disagreement (75) responses suggest that some respondents appreciate the possibilities these technologies offer, but many others also seem to question their practicality and relevance within library science.

H. Formal Training or Workshops

Unfortunately, the statistics show that formal training or workshops on AI/ML are not widespread. Out of the 100 participants who disagreed or strongly disagreed, there seems to be a gap in formal training resources which could impede the appropriate use and adoption of AI/ML technologies. This indicates that there are inadequate tailored teaching resources designed that aim to improve understanding and mastery in these fields.

I. Keeping Updated with Developments in AI/ML

The fairly equal distribution of answers suggests active participation in newer advancements in AI/ML among library science professionals. While 80 participants chose the neutral option, the absence of strong agreement or strong disagreement suggests that many are not quite decided on the matter. Participants actively working in the field do seem to track some new developments, however, it appears that a sizeable portion of the population does not attempt to engage with current new literature which may be due to lack of time or other pertinent useful materials.

J. Confidence Regarding AI/ML Discussion

The confidence level in discussing AI/ML is lower than expected given that 110 respondents disagreed or strongly disagreed. This indicates that even if a few individuals possess a basic understanding of AI/ML, they do not seem to have the confidence or the skill level required to participate meaningfully in conversations regarding these technologies. This suggests that there is a problem with education, or perhaps more accurately, an absence of adequate teaching and professional advancement resources needed to address this problem.

TABLE 3
INFRASTRUCTURE AND RESOURCE READINESS

Statement	1	2	3	4	5
My library has adequate IT infrastructure to support AI/ML integration.	15	40	90	70	35
Our current library management system supports AI-based features or tools.	25	50	80	60	40
Technical support staff are available to implement AI/ML systems in our library.	20	45	85	50	50
Financial resources are available for investing in emerging technologies like AI/ML.	35	55	95	65	40
The organization has a clear strategy or policy regarding AI/ML adoption.	30	50	85	70	45

The above table presents the frequency distribution of responses for the Infrastructure and Resource Readiness section. The responses are categorized into five Likert scale options: Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree (1,2,3,4, and 05).

K. Adequate IT Infrastructure to Support AI/ML Integration

The majority of survey participants (90 respondents) were neutral regarding the adequacy of the library's IT infrastructure to incorporate AI/ML, suggesting indecisiveness or mixed feelings about the issue. Even so, 105 respondents either agreed or strongly agreed, which indicates that there is some level of perception that the existing infrastructure could support, at a minimum, some degree of AI/ML functionalities. Moreover, the 55 respondents who disagreed or strongly disagreed pointed out that there are, indeed, gaps with regard to IT capabilities aimed at fully AI/ML infrastructure.

L. Library Management System's Support for AI-Based Features or Tools

The data highlights that a significant proportion of libraries are still operating without systems that feature AI-based tools, demonstrated by 75 respondents who chose to disagree or strongly disagree with the statement. Still, 100 participants agreed or strongly agreed, which indicates that there is some amount of readiness to use AI/ML tools in library management systems. The data suggests a shortfall in the availability or implementation of AI-based features in system infrastructures.

M. Availability of Technical Support Staff for AI/ML Implementation

The gaps in employing relevant staff for implementing AI and machine learning in institutions shows that there is a neutral suggestion that most libraries lack accessible skilled labor AI and ML implementation (85). The results from the other respondents strongly indicates most libraries have the necessary technical personnel albeit with some inconsistencies across institutions(The other 100 agreed or strongly agreed). This suggests that while some libraries are prepared to use AI and ML systems others have problems integrating because of a lack of staff Specialized in technical services. The libraries and other learning institutions feel less AI and ML nurturing systems ('s with a negative 90 suggesting institutions lack the funds needed to enable essential purchase of the tools). A disputable number of respondents also agree funds are readily available(105 agreed or strongly agreed). Unlike other institutions this factor-less institution's spending capabilities on modern tech makes adopting such technologies very hard. Institutions suffer lack of funds while others claim to have sufficient funds for implementing AI and Machine Learning.

N. Financial Resources for Investing in AI/ML Technologies

The respondent librarians reveal there being lower funds attributed towards the enhancement of emerging tools and systems AI/ML technologies. Alongside each question posed to the participant there was room for added comment. An example of this could be in which they were told to explain why they deem funds for AI/ML tools lacking. It indicates absence of flexible funds which in turn gives reason to argue why the majority disagree with the fact that those advanced technologies considered for funding are put in place. Through bringing this to one attention paints the broader picture of granted funds belonging to discrete programs being guarded zealously. Such fluent wording contradicts the willingness displayed to bring emerging technologies into the library setting. In response to the hybrid open-ended question surrounding

whether or not tangible funds are made available, a diverse array of different reasoning answers reveal participant librarians lacking the perceived funds. Thus, it can be inferred that there are differing stances when it comes to the libraries being funded for AI tasks. Out of the total number of participants, only 90 expressed the neutral stance, parting away from disagreeing where most of them seem to freely float around disagreeing or strongly disagreeing with concern.

O. Clear Strategy or Policy Regarding AI/ML Adoption

The majority, 85 respondents, were neutral about the organization having a clear strategy for AI/ML adoption; however, 115 participants either agreed or strongly agreed that their organization has a strategy or a policy. This indicates that most libraries are developing or have already developed plans for AI/ML integration. At the same time, the neutral responses suggest that some institutions might be unclear about these plans at different organizational levels.

TABLE 4
ATTITUDES AND WILLINGNESS TO ADOPT AI/ML

Statement	1	2	3	4	5
I believe AI/ML can significantly improve library services and operations.	45	40	60	50	55
I am open to using AI-based tools in my daily library activities.	50	40	70	65	60
I would participate in training programs to learn how to use AI/ML tools effectively.	60	50	65	55	60
I am concerned that AI might replace human roles in libraries.	30	35	50	70	40
I am willing to advocate for AI/ML implementation in my institution.	65	45	70	60	55

The above table 4 presents the frequency distribution of responses for the Attitudes and Willingness to Adopt AI/ML section. The responses are categorized into five Likert scale options: Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree (1,2,3,4,5).

P. Belief that AI/ML Can Improve Library Services and Operations

The data broadly shares enthusiasm toward the capability of AI\ML improving library services, with 105 respondents agreeing or strongly agreeing. However, 85 respondents were non-committal, suggesting vague understanding or unfamiliarity with the utility of AI\ML services. The remaining 85 disagree or strongly disagree suggest that a minority of participants become cynical regarding the pragmatic use AI\ML can offer in library operations. In general, some propels the use of AI\ML in library processes while other factors render obstacles to unqualified endorsement.

Q. Openness to Using AI-Based Tools in Daily Library Activities

The responses indicate an overwhelming willingness to adopt AI based tools, as 130 respondents showed agreement or strong agreement. This means that the majority of respondents would be willing to use AI in their daily activities in the library. Nevertheless, 90 respondents being indifferent, or disagree point out that there is some degree of reluctance to accept these tools. The positive majority indicates that proper and adequate support will enable these proposed tools to be incorporated into library practices.

R. Willingness to Participate in AI/ML Training Programs

Over the half of the total respondents (which is 120) indicate that they are willing to partake in some form of training aimed at teaching them how to efficiently use AI and ML tools. This suggests that professional development in this scope is indeed very high and comes with advent of new skills. Additionally, however, 110 participants neutral or disagree which suggests that people might not know about highly available training programs or are skeptical to the time and effort that they would have to devote to the training. Perhaps Libraries need to provide a more overwhelming or simpler learning environment in order to meet this expectation on their skill set.

S. Concerns About AI Replacing Human Roles in Libraries

Fears of AI taking over human roles is of great magnitude with 115 respondents showing concern AI taking over roles (sum of disagreement and strong disagreement) in libraries. This highlights the fact that a lot of participants seem to be rather reluctant or even scared of the employment opportunities that AI poses. A

neutral stance is taken by 110 respondents which provides some indication of uncertainty which almost cancels out the importance of AI. The data substantially does capture the understanding level that AI poses concerning employment opportunities is quite daunting. We should address these problems by explaining things clearly while bringing focus to the possibilities of AI being used for assisting people instead of shifting to them.

T. Willingness to Advocate for AI/ML Implementation in the Institution

The AI/ML adoption advocacy willingness data shows that out of the total respondents, 115 are ready to support the adoption of AI/ML technologies in their institutions, which demonstrates a considerable conscience toward advocacy. Nevertheless, there is a considerable amount of 110 respondents who neither agree nor disagree. This statement indicates that while some are keen, there is a lack of enthusiasm in being active advocates for change. Promotion of participation and advocacy through leadership roles and increased tell AI advocacy activities may be what is needed at most libraries.

VI. DISCUSSION

The results from this research offer useful information regarding the perception, technological preparedness, and integration of Artificial Intelligence (AI) and Machine Learning (ML) into library systems. The respondents show a high degree of familiarity with AI/ML related to library work including a considerable proportion that understands its workings and applications, which is encouraging. On the other hand, knowing how AI/ML applies in libraries is rather low. This means that although there is some awareness of AI/ML among library personnel, it appears that there is little actual knowledge of the applicable technologies and their implications for library operations, which can be addressed through further educational training materials.

With regard to infrastructure and resource preparedness, the outcomes show a balanced outlook. A large portion of respondents claim that their libraries have at least some level of IT infrastructure that could integrate some AI/ML tools, however, there is still doubt regarding the adequacy of these resources for full integration. The absence of adequate technical expertise in a number of these libraries, combined with limited budget options, tends to pose a more serious obstacle toward the system wide implementation of AI/ML technologies. Libraries that do have greater funding and better qualified personnel tend to be more prepared for AI/ML integration. On the other hand, less resourced institutions may have great difficulty adopting these technologies, although many appear to be interested in exploring them.

The attitudes and approaches to the adoption of AI/ML are positive, even with the existing infrastructure issues. Many of the respondents are ready to adopt AI and ML technologies and believe that such technologies can improve service delivery at the libraries. This is further evident in the participants' eagerness to attend training sessions, which implies that they want to improve their skills professionally. Notwithstanding, there is still apprehension from several participants regarding the replacement of library jobs due to advances in AI technologies. This suggests, however, that there is still a large gap in the information that library staff receive on how AI can be integrated to support human work instead of supplanting it.

In particular, the findings highlight the need for coherent strategic framework and policy formulation regarding AI/ML use in libraries. While some libraries have a policy related to AI/ML integration, a considerable number of respondents appear neutral or unsure about the strategy employed in their institutions. In this regard, libraries need to develop and communicate openly defined plans concerning the adoption of AI/ML technologies to alleviate apprehensiveness and instill greater trust in these technologies. Generally, the findings suggest that, despite libraries recognizing the potential of AI/ML, their ability to integrate these technologies is precluded by the absence of adequate infrastructure, limited resources, and apprehensions surrounding job losses. The described challenges seem to require specific training, deliberate planning, and resource distribution to be effectively managed for successful AI/ML integration in the future.

VII. CONCLUSION AND RECOMMENDATIONS

This research analyzes the preparedness of academic libraries in Islamabad to integrate Artificial Intelligence (AI) and Machine Learning (ML) technologies. The findings indicate that there is basic

cognizance of AI and ML amongst library practitioners; however, their understanding of the applicability of these technologies towards library functions is shallow. In addition, although most of the respondents recognize the advantages of AI and ML in improving library services, gaps in infrastructural resources, inadequate advanced technical skills, and limited funding are major constraints to full adoption. As noted in this study, the perceptions regarding the integration of AI/ML are positive, however, there is minimal capability for integration in many libraries due to resource constraints and a lack of clear strategic policies.

After evaluating the findings, it is suggested that the libraries located in Islamabad focus on developing their technological infrastructure to directly integrate AI/ML features. This would require modifications to the current software systems used in the libraries, as well as access to proper technical support. Moreover, the bridging the knowledge gap library practitioners is crucial and so is fostering advanced communication training. Effective training should emphasize practical involvement in AI/ML activities for those willing to partake in such programs, and who trained so they can obtain higher levels of employment.

Moreover, something must be done about the reluctance to with AI/ML technologies. It is very important for libraries to fight for more funding from within their institutions, and from outside the institutions, particularly targeting accessible funding for technological advancement and career growth. Working with national agencies as well as educational oversight bodies and funding bodies can help identify the appropriate requirements to support the effective use of AI/ML technology.

The research also highlights policies of an operational nature stealth AI ML strategies to address policies for Academic Libraries as proprietary copyright fiction works of unprecedented prestige and reverence. All libraries must ensure that coherent plans for AI ML implementation are crafted and all stakeholders have the same understanding that it is the robotics that are the intelligent fools of the future. Such plans will arrest the deep seated fear for professional displacement by AI. Simultaneously, they will begin to view the role of AI as enabling libraries professionally and not detrimentally.

Moreover, undertake additional investigations aimed at examining the impact of AI ML adoption on services and staff interactions of the library long term. Such research would go a long way in establishing how AI ML technologies can be integrated within libraries and how they can enhance user engagement as well as operational effectiveness. Islamabad libraries aim at development and give emerging technologies gentle prominence not primacy over why, but how do we ensure libraries advance use of ICT.

REFERENCES

[1] M. Ahmed, M. Mukhopadhyay, and P. Mukhopadhyay, "Automated knowledge organisation: AI/ML-based subject indexing system for libraries," *DESIDOC J. Lib. Inf. Technol.*, vol. 43, no. 1, 2023.

[2] S. M. Ali, A. Razzaque, M. Yousaf, and R. U. Shan, "An automated compliance framework for critical infrastructure security through artificial intelligence," *IEEE Access*, 2024.

[3] M. Asim and M. Arif, "Internet of things adoption and use in academic libraries: A review and directions for future research," *J. Inf. Sci.*, p. 01655515231188338, 2023.

[4] M. Asim, M. Arif, M. Rafiq, and R. Ahmad, "Investigating applications of artificial intelligence in university libraries of Pakistan: An empirical study," *J. Acad. Librariansh.*, vol. 49, no. 6, p. 102803, 2023.

[5] M. Baber, K. Islam, A. Ullah, and W. Ullah, "Libraries in the age of intelligent information: AI-driven solutions," *Int. J. Appl. Sci. Res.*, vol. 2, no. 1, pp. 153–176, 2024.

[6] A. K. Bhattacharya, "Innovations in library services: The integration of artificial intelligence and machine learning in modern libraries," *Lib. Prog.-Lib. Sci. Inf. Technol. Comput.*, vol. 44, no. 3, 2024.

[7] C. Boman, "An exploration of machine learning in libraries," *Lib. Technol. Rep.*, vol. 55, no. 1, pp. 21–25, 2019.

[8] R. Cordell, "Machine learning + libraries," *Library of Congress*, Washington, DC, Jul. 2020. [Online]. Available: https://labs.loc.gov/static/labs/work/reports/Cordell-LOC-ML-report.pdf

[9] A. Cox, "How artificial intelligence might change academic library work: Applying the competencies literature and the theory of the professions," *J. Assoc. Inf. Sci. Technol.*, vol. 74, no. 3, pp. 367–380, 2023.

[10] R. K. Das and M. S. U. Islam, "Application of artificial intelligence and machine learning in libraries: A systematic review," *arXiv:2112.04573*, 2021.
[11] C. K. Gajbhiye, "Impact of artificial intelligence (AI) in library services," *Int. J. Multidiscip. Res.*, vol. 6, no. 3, pp. 1–12, 2024.
[12] A. D. Gbadebo, "Application of artificial intelligence and machine learning in academic libraries," *Int. J. Soc. Educ. Innov.*, pp. 184–201, 2024.
[13] M. R. Haque et al., "The role of macroeconomic discourse in shaping inflation views: Measuring public trust in federal reserve policies," *J. Bus. Insight Innov.*, vol. 2, no. 2, pp. 88–106, 2023.
[14] A. Hussain, "Use of artificial intelligence in the library services: Prospects and challenges," *Lib. Hi Tech News*, vol. 40, no. 2, pp. 15–17, 2023.
[15] A. Hussain and S. Ahmad, "Mapping the literature on artificial intelligence in academic libraries: A bibliometrics approach," *Sci. Technol. Lib.*, vol. 43, no. 2, pp. 131–146, 2024.
[16] U. F. Ikwuanusi et al., "Leveraging AI to address resource allocation challenges in academic and research libraries," *IRE J.*, vol. 5, no. 10, p. 311, 2022.
[17] M. S. Islam et al., "Machine learning-based cryptocurrency prediction: Enhancing market forecasting with advanced predictive models," *J. Ecohumanism*, vol. 4, no. 2, pp. 2498–2519, 2025.
[18] I. U. Khan et al., Eds., *Artificial Intelligence for Intelligent Systems: Fundamentals, Challenges, and Applications*, 2024.
[19] P. Knoth, "Applications of AI in academic libraries and archives: Machine learning from and for open research," *Univ. Chicago Lib. Futures Speaker Ser.*, Aug. 2023.
[20] T. Mariprasath, K. R. Cheepati, and M. Rivera, *Practical Guide to Machine Learning, NLP, and Generative AI: Libraries, Algorithms, and Applications*. CRC Press, 2024.
[21] S. Mishra, "Ethical implications of artificial intelligence and machine learning in libraries and information centres: A frameworks, challenges, and best practices," *Lib. Philos. Pract.*, 2023.
[22] S. Naikar et al., "Artificial intelligence (AI) in academic libraries: A theoretical study," in *Multidisciplinary Approach to Information Technology in Library and Information Science*, IGI Global, 2024, pp. 81–97.
[23] S. Nazeer and Y. Gil, "Embracing artificial intelligence challenges for public sector organizations in Pakistan," *J. Contemp. Stud.*, vol. 12, no. 1, pp. 35–52, 2023.
[24] T. Padilla, *Responsible Operations: Data Science, Machine Learning, and AI in Libraries*. OCLC Res., 2019.
[25] S. Panda and R. Chakravarty, "Adapting intelligent information services in libraries: A case of smart AI chatbots," *Lib. Hi Tech News*, vol. 39, no. 1, pp. 12–15, 2022.
[26] S. Priya and R. Ramya, "Future trends and emerging technologies in AI and libraries," in *Applications of Artificial Intelligence in Libraries*, pp. 245–271, 2024.
[27] A. Shabbir et al., "Analyzing surveillance videos in real-time using AI-powered deep learning techniques," *Int. J. Recent Innov. Trends Comput. Commun.*, vol. 12, no. 2, pp. 950–960, 2024.
[28] K. Shahzad et al., "Identifying university librarians' readiness to adopt artificial intelligence (AI) for innovative learning experiences and smart library services: An empirical investigation," *Glob. Knowl. Mem. Commun.*, 2024.
[29] I. Sultana et al., "SmSeLib: Smart & secure libraries—Navigating the intersection of machine learning and artificial intelligence," 2024.
[30] A. Ullah and M. Usman, "Role of libraries in ensuring quality education at higher education institutions: A perspective of Pakistan," *Inverge J. Soc. Sci.*, vol. 2, no. 4, pp. 13–22, 2023.
[31] A. Ullah, M. Usman, and M. Baber, "Role of libraries in enhancing research support services in Islamabad universities," *J. Soc. Sci.*, vol. 14, no. 1, pp. 40–55, 2023.
[32] A. Wheatley and S. Hervieux, "Artificial intelligence in academic libraries: An environmental scan," *Inf. Serv. Use*, vol. 39, no. 4, pp. 347–356, 2019.
[33] J. Wu et al., "Citeseerx: AI in a digital library search engine," *AI Mag.*, vol. 36, no. 3, pp. 35–48, 2015.

[34] M. Z. Afshar and M. H. Shah, "Performance evaluation using balanced scorecard framework: Insights from a public sector case study," *Int. J. Hum. Soc.*, vol. 5, no. 1, pp. 40–47, 2025.
[35] M. Zareef, M. Arif, and M. Jabeen, "Research trends in LIS: The case of doctoral research in Pakistan, 1981–2021," *J. Librariansh. Inf. Sci.*, vol. 56, no. 3, pp. 658–676, 2024.
[36] M. S. Islam et al., "Machine learning-based cryptocurrency prediction: Enhancing market forecasting with advanced predictive models," *J. Ecohumanism*, vol. 4, no. 2, pp. 2498–2519, 2025.
[37] F. T. Zohora, R. Parveen, A. Nishan, M. R. Haque, and S. Rahman, "Optimizing credit card security using consumer behavior data: A big data and machine learning approach to fraud detection," *Frontline Mark., Manag. Econ. J.*, vol. 4, no. 12, pp. 26–60, 2024.
[38] W. Ullah, M. Usman, and A. Ullah, "Usage of e-resources among the students of GCUF library," *Int. J. Sci. Multidiscipl. Res.*, vol. 2, no. 2, pp. 153–168, 2024.
[39] M. Assefi, E. Behravesh, G. Liu, and A. P. Tafti, "Big data machine learning using Apache Spark MLlib," in *Proc. IEEE Int. Conf. Big Data (Big Data)*, Dec. 2017, pp. 3492-3498.
[40] M. Asif and M. S. Sandhu, “Social Media Marketing Revolution in Pakistan: A Study of its Adoption and Impact on Business Performance”, *JBII*, vol. 2, no. 2, pp. 67–77, Dec. 2023.
[40] W. Kamupunga and Y. Chunting, "Application of big data in libraries," *Int. J. Comput. Appl.*, vol. 178, no. 16, pp. 34-38, 2019.