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## Transforming Academic Libraries in Pakistan through AI for Inclusive Education: Enhancing Access and Engagement for Students

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### ABSTRACT

*With the evolution of higher education in Pakistan, academic libraries are increasingly adopting the use of artificial intelligence (AI). Libraries often face financial constraints that limit their ability to cater to students with diverse needs. AI is an innovative instrument that provides individual learners with an individually tailored educational experience. As for the case of AI technologies, the uptake is comparatively nascent to a level where AI technologies execute all-inclusive functions in institutions. Chatbots and Speech-to-Text Technology are extremely useful in satisfying students' academic needs as these are personalized, robust services. The more advanced AI tools, such as Voice Searching, Intelligent Data Analysis, and Image Recognition, have been adopted more slowly and have lower levels of user satisfaction. This research aims to investigate the current status of AI services in academic libraries of Pakistan, as well as user perspectives and satisfaction levels regarding these digital technologies. The purpose of this study is to investigate the AI-driven transformation in Pakistani academic libraries, with a specific focus on enhancing accessibility and engagement experiences for students. This study aims to explore the feasibility of implementing AI-based services in academic libraries in Pakistan, assess student satisfaction with AI technologies, and evaluate the potential impact of these tools on students' learning experience. The study employs a quantitative research design, collecting data through structured questionnaires disseminated to students. The questionnaire was designed to focus on assessing students' knowledge, satisfaction, and the impact of AI-based services adopted in academic libraries. SPSS software was used to analyze the collected data from students to validate these findings through statistical analysis. Findings of the study reaffirm that the implementation of AI tools, including Chatbots and Speech-to-Text Technology, has significantly increased Students's engagement and*

*satisfaction levels in academic libraries in Pakistan. These tools are rated highly, particularly because of their usefulness and effectiveness at meeting the academic requirements of Students. On the other hand, tools like Voice Searching and Intelligent Data Analysis exhibited lower satisfaction ratings, indicating that these functions are not meeting user expectations. The results demonstrate that AI can revolutionize library services, but continued development is required for efficient and scalable implementation of AI technology.*

**Keywords:** Artificial intelligence (AI), academic libraries, AI based library services, personalized learning, student engagement, educational outcomes, Pakistan.

### **Introduction**

With the progress of the world's higher education, academic libraries in Pakistan today are also integrating artificial intelligence (AI) in their work. AI has advanced through computers and associated technologies, evolving into intelligent education systems accessible online. Over time, the integration of embedded computing and other technologies enabled the use of humanoid robots and web-based Chatbots to fulfil instructional roles, either autonomously or in partnership with human teachers. Moreover, these systems harness machine learning and adaptive capabilities to tailor and personalize curriculum and content to suit individual student needs. This approach has heightened student engagement and retention, enhancing the overall learning experience and quality of education. AI technologies such as uses of Chatbots, speech to text services, voice search options can greatly enhance the level of engagement of students with libraries and in the process enhance student's access to information, thus helping create a more inclusive and diverse learning environment. However, the prospect of these tools is promising because most Pakistani university libraries are in the early stage of incorporating AI-based solutions which reveals several implementation and usage gaps, (Asim et al., 2023).

Artificial Intelligence is reshaping academic libraries, especially in developing countries like Pakistan. AI-powered solutions have gradually become essential in library services as the student population that primarily belongs to Students, a generation of digital natives, continues using them, and their needs necessitate the use of AI. This study aims to investigate the innovative contributions of AI in making Pakistani Academic Libraries more dynamic, efficient & user-friendly using tools like Chatbots and Speech-to-Text Technology, etc. Results of the study demonstrated positive perception towards these technologies; students find them mostly easy and enjoyable to use, along with receiving instant support. However, the study also indicates that there is still a lot of room for development and integration when it comes to more advanced AI features such as Voice Searching, Intelligent Data Analysis, and the like. Ultimately, a way forward needs to involve leveraging the vast potential of AI library services through user-centered design, retention of staff, and sustained technological advancements to cultivate an inclusive and engaging learning environment that Students learners demand.

This study contributes to the existing body of knowledge on AI in education by establishing its applicability and the benefits of the latter in terms of results, specifically in the Pakistani setting and other developing zones facing similar learning system issues.

### **Research gap and significance of the study**

While there is extensive research available globally on AI applications in academic libraries, there is a notable scarcity of studies focusing on the specific context of Pakistan, particularly concerning students. Existing literature (Khan et al., 2025) provides insights into AI applications in Pakistani university libraries; however, these studies often lack a comprehensive national perspective and

do not delve deeply into user satisfaction or the impact on student engagement and accessibility. Many studies (Ali et al., 2025; Naseer et al., 2025; Amin & Uddin, 2023) explore AI integration in medical and general education, despite limited infrastructure, but do not specifically address its role in academic libraries or its effects on library users. This underscores the need for focused research on AI's impact within the library sector, particularly in enhancing services for students. This study aims to fill these gaps by providing a comprehensive analysis of AI applications in Pakistani academic libraries, evaluating their impact on accessibility and engagement among students. This study may offer insights to scholars and libraries in measuring the feasibility, satisfaction and impact of AI-based services by providing information that can lead to more inclusive education environments. These results can inform future policy and technological advancements in academic libraries, ultimately leading the trend in the higher education sector in Pakistan.

### **Objectives**

Objectives of the study is as follows:

1. To explore the range of AI-based services currently deployed in academic libraries in Pakistan.
2. To measure the satisfaction level of the students regarding the use of AI technologies in the context of Pakistani academic libraries.
3. To understand the impact of AI-based library services on learning Experience and academic engagement among students in Pakistani academic libraries.

### **Literature Review**

Introducing AI technology in learning institutions has been more of a revolution especially in teaching and learning processes. Intelligent tools applied in personalized learning environments have been very effective in increasing learners' engagement, skills acquisition, and access to learning materials. It has been found in the literature that approaches such as adoption of personalized learning in a classroom can greatly improve students' interest and productivity (Chen et al., 2020). Using machine learning algorithms, the AI systems can identify the performance of students and propose teaching methods in response with better learning information (Baker & Smith, 2019).

It has also contributed to enhancing skill acquisition among people. With the use of AI in delivery of education, students receive educational feedback in real time and personal learning trails which are essential in problem solving skills (Zawacki-Richter et al., 2019). For that same reason, AI technologies can pinpoint areas of the curriculum which students are having difficulty with and then suggest appropriate remedial steps, which makes the learning process more efficient (Roll & Wylie, 2016). This approach enhances the delivery of education since every student has different needs thus will be beneficial in enhancing their learning needs.

One more advantage of using AI solutions within the educational system is the accessibility of the studying materials. In detail, integration of the AI technologies can address different learning requirements such as those of learners with disabilities (Holmes et al., 2019). In this way, with the help of AI, people receive individual lessons with the result that every learner can succeed in the classes. This is especially so in the context of such developing countries as Pakistan where available education resources are rather confined and there is a great need to come-up with solutions that can improve the efficiency of the process (Rehman et al., 2020; Jabeen, Faraz, & Jabeen, 2024).

The areas of societal positive impact which are associated with the long-term effects of AI education are, improved quality of education, and producing a workforce relevant for the future. AI based educational initiatives can equip students with skills for the existing dynamic marketplace (Luckin et al., 2016). However, the long-term success of such initiatives has been dependent on investment in AI, as well as ongoing professional development of educators that can include the use of AI technologies (Selwyn, 2019). Pakistan has shown signs of using Artificial intelligence particularly for education where several pilot initiatives have yielded positive results (Ahmed and Waqar, 2021). Nevertheless, implementing AI in education has some challenges as discussed below. There are challenges regarding data privacy as well as the overall question on the ethical application of artificial intelligence (Williamson, 2017). That is why there is a demonstrated need for the strong paradigm to establish and monitor the transparency and accountability of AI applications introduced in education processes (Aiken, 2019). These concerns are even more important in Pakistan since the implementation of AI in educational sector is still in its infancy and because of the issues related to data security and privacy which are already present in the country (Naseem et al., 2021 & Jabeen et al., 2020).

As the AI technology is being progressively adopted in academic libraries across the global context, little research has explored the use of AI in the setting of Pakistani universities. Though such works as Ahmed et al., (2023) and Shah & Malik, (2022), aim at early engagement and applying relatively simple CA tools, Chatbots, and voice search, their contribution to the analysis of the users' satisfaction and overall learning outcomes is insufficient. Furthermore, there is dearth of published research identifying ways in which digitization influences the future development of education in the Pakistani academic libraries Jabeen et al., 2017. Hence, this study fills gaps by providing a detailed evaluation of the current AI-based library services in terms of the utility customers derive from them as well as possible long-run effects, making useful contributions toward determining the nature of the AI revolution in developing countries.

### **Research methodology**

The study focused on a diverse group of students from universities across Pakistan. The population comprised undergraduate students, recognized as digital natives of Students, who are highly exposed to technology and actively utilize library services. With the definite number of 380 students' various analyses were completed in order to provide the most representative and statistically significant result, regarding the chosen confidence level of 95% and an acceptable error of 5%. To capture true sampling of the target population, the study used the stratified random sampling technique where the strata included the university students and the students' level of study. This kind of approach made it possible to accumulate information from a greater number of students and, therefore, the results are likely to be more generalized and inclusive of more students.

In addition, a pilot study of 30 students was conducted to assess the understandability and credibility of the survey questionnaire. The first research question of the pilot study was to determine any problems concerning the wording, structure and length of the questionnaires besides confirming if the questions measured the intended variables. Essential changes that could make it clearer and more relevant were made to this pilot based on the feedback received back. The last questionnaire was administration in many ways including physically by the author, online through e-mail and social media accounts to students in the selected university. Therefore, the online method of distribution was selected well in line with the population and community needs

of the target users and because the method is convenient, cheap and would cover a wide demographic area. Also, the fact that the data were collected through the Internet meant that the data were brought in a more structured way and with the least distortion.

### **Validity and Reliability**

For the validity of the questionnaire, the survey items were constructed from literature review and discussion with the academicians and industrial professionals in the fields related to AI and education. The steps mentioned above effectively address the questions of content validity to guarantee the coverage of all the aspects related to AI-based services in the context of academic libraries in the foreseeable expert reviews. The internal consistency of the scales used in the study was estimated by Cronbach's alpha coefficient in terms of reliability. The data of the pilot study were collected, and the Cronbach's alpha coefficient was computed for all the sections of the questionnaire. A coefficient of 0.7 or higher is considered acceptable based on the acceptable level of the survey items. Therefore, the survey items used to measure the constructs are well designed. Any items did not fit this criterion were modified or deleted to improve the objectivity of the instrument.

### **Analysis and Discussion**

#### **Frequency of using AI-based services in the library**

The analysis of frequency of usages AI library services is shown in Table: 1 Only 35 students from a total of 380 (9.21%) selected rarely to use the AI services meaning not most interacted with this tool often. The AI services of the library are occasionally used by 55 students (14.47%), gradually reflecting a partially utilized usage pattern.

**Table: 1 Frequency of using AI-based services in the library**

Scale	Number of Students	Percentage %
Rarely	35	9.21
Occasionally	55	14.47
Sometimes	80	21.05
Often	100	26.32
Very Often	110	28.95
Total	380	100

A group of 80 students (21.05%) which is a percent less used it than sometimes also demonstrating some engagement. The data informs that 100 students (26.32%) often use AI library services with the largest group, 110 students (28.95%), who use them adequately. Both counts together make a good number (55.27%) and proves its importance in the daily life as student political block lies on their heads, they keep using AI tools way too much every now and then acknowledge it or not? This reiterates the necessity to start and strengthen AI library services that contribute positively to student success.

#### **Usability of AI-Based Library Services**

Table: 2 shows the Chatbots are used widely, and Speech-to-Text Technology has also mainly been implemented for extracting data from account owners. The other services have less usage, indicating differences in technologies used by libraries to implement AI. Practicality and cost-effectiveness have made Chatbots and Speech-to-Text Technology the most used cost-effective solutions for academic libraries in a developing country like Pakistan (Ali et al. 2022). Chatbots are an efficient front-line solution as they provide immediate, real-time guidance such that customers do not need to wait long for a reply, a critical feature in areas with scarce staff and resources. They

are a good solution for answering student questions and supporting library functions with limited human resources. Just as much, students use Speech-to-Text Technology to significantly assist them in academics work such as when taking notes or researching. This tool can be very useful for places where there are not many advanced educational resources and is important to make data collection easier. The diminished usage of other AI tools, which is Google Assistant for Voice Search or Intelligent Data Analysis, seems to be the result of low awareness of and limited availability of those tools. Many of the libraries in Pakistan have probably Digital Reasoning systems to library buildings due to budget constraints or technical limitations, which impacts the spectrum of services available. Thus, while Chatbots and Speech-to-Text Technology meet the exact requirements of the existing academic curriculum, the adoption of more advanced AI tools is still in progress in these educational institutions.

**Table: 2 Usability of AI based library services**

AI-Based Library Service	Percentage (%)
Chatbots	80.77
Speech-to-Text Technology	40
Google Assistant for Voice Search	30
Text-to-Speech Technology	25
Natural Language Processing Tools	20
Voice Searching	18
Intelligent Data Analysis for Collection Management	10
None of the Above	6.23

The relatively lower adoption of other AI tools, such as Google Assistant for Voice Search or Intelligent Data Analysis, might stem from limited awareness or availability. Libraries in Pakistan may have introduced only a select range of AI-based tools due to budget constraints or technological limitations, thereby affecting the variety and extent of AI services available to students (Senthilkumar et al., 2024). Additionally, the implementation of more complex AI tools may require infrastructure and training that are still developing in many academic settings.

#### **Students' satisfaction of AI based library services**

In table: 3 It has been established from the findings that speech-to-text technology and Chatbots receive the most satisfaction with 55% and 60% of respondents rating them very satisfied respectively. Conversely, Intelligent Data Analysis for Collection Management and Voice Searching have been appreciated at a lower level such that 10% and 9% of respondents were very unsatisfied respectively.

**Table: 3 Satisfaction with AI based library services**

Service	1	2	3	4	5
			%		
Text-to-Speech Technology	5	10	15	30	40
Speech-to-Text Technology	3	7	10	25	55
Google Assistant for Voice Search	6	9	14	22	49
Intelligent Data Analysis for Collection Management	1	15	25	20	30
Natural Language Processing Tools	7	13	22	24	34

<b>Voice Searching</b>	9	11	21	19	40
<b>Chatbots</b>	4	6	10	20	60

Five-point Likert scale ranging highly dissatisfied- highly Satisfied

There are several reasons which explain the relatively low satisfaction levels for some of AI based library services in use. In the case of Intelligent Data Analysis for Collection Management for example, students' discontent may come from the fact that this function is specific and does not always provide much value in terms of general, day to day usage of the library. This service is meant for the librarians and not for the students, which is why the students may not fully comprehend or make use of its functions completely. Also, if the analytical software is poorly designed or does not fit properly within the existing workflow, students' satisfaction levels drop even more. Satisfaction voiced regarding Voice Searching was also lower due to users' perceptions of such functionality being limited or problems with its functionality's inclusiveness. Disappointment and inefficiencies due to misinterpretation of search queries affect users greatly especially if the system is still developing or not designed to the needs of students. In contrast, Speech-to-Text Technology and Chatbots obtain user satisfaction ratings that are higher because they present simple and practical offerings. Speech-to-Text aids not only in efficiency but also in accessing information, while Chatbots offer the advantages of immediate, real-time assistance and problem-solving, so the user experience is greatly enhanced.

#### **Impact of AI based library services**

Table 4: Survey results to assess the strengths and weaknesses of AI-based service in the library in the following respects, i.e., user Engagement, searching capabilities, educational collection accessibility, and finally, long-term educational impact. It lists, means, standard deviations (SD), and percentage of those who agreed or strongly agreed with the statements on a Likert scale 1–5 (1: Strongly Disagree, 5: Strongly Agree). The Mean and SD give a general indication of response central tendency and spread. The statistical analysis of user responses emphasizes the positive impact of technology-powered initiatives in academic libraries, which is in line with previous studies (Okunlaya, 2022; Jabeen et al., 2018).

#### *AI-based services engagement and satisfaction (Q1, Q6)*

The two constructs with the highest mean are: "I am satisfied with the quality of AI-based services provided by the library" (Mean = 4.21) and "AI-based services provided in the library have increased my engagement" (Mean = 4.27). These high average scores reflect the overwhelmingly positive attitudes of most participants towards the effects of AI on library experience and service satisfaction, instilling a sense of optimism about the potential of AI in libraries. Positive answers may also indicate that AI tools make a difference in improving human library user interaction and in improving information access and usage (Manning et al., 2016). These results are consistent with previous findings to suggest that AI-based systems pave the way for more user-friendly and personalized services in libraries (Tyagi et al., 2024). In addition, the employment of AI in the library may also be seen as a proactive move to develop an empowering and learner-centered environment (Priya & Ramya, 2024).

#### *Long-Term Educational Impact (Q8)*

The item 'I think the library's AI-powered services will be beneficial in the long run for my education' also garnered a high mean score of 4.27. This suggests that users are optimistic about the potential long-term benefits of integrating AI into the library's service environment. This anticipation of future benefits underscores the value of AI integration and provides a strong



impetus for further research and development in this area. AI has the potential to significantly transform the learning experience through personalized learning tools, resource suggestions, and cognitive support (Chen et al., 2020). The high mean score for the item 'I think the library's AI-powered services will be beneficial in the long run for my education' (4.27) suggests that users are aware of this potential and are looking forward to the long-term benefits of AI integration. This underscores the significance of AI in education and encourages further exploration of its transformative potential.

**Table 4: Impact of AI based library services on students learning**

Questions	1	2	3	4	5	Mean	SD
The AI based services offered in the library have increased my engagement.	2.63	3.95	9.21	31.58	52.63	28.51	21.65
I have noticed improvements in my search capabilities due to AI-based services provided by the library."	1.32	5.26	11.84	34.21	47.37	81.58	19.9
The library's use of AI based services has made educational resources more accessible to me.	1.32	3.95	7.89	39.47	47.37	86.84	21.69
I believe that the library plays an important role in promoting inclusive AI services and accessibility to resources.	2.63	5.26	9.21	36.84	46.05	82.89	19.98
The library has become a more vibrant learning hub since the implementation of AI based services.	10.00	5.26	8.24	34.21	42.11	76.32	16.9
I am satisfied with the quality of AI based services offered by the library.	1.84	4.74	9.21	36.84	47.37	84.21	20.69
AI based services has enhanced my efficiency completing academic tasks.	2.11	3.95	10.53	38.16	45.26	83.42	20.22
I believe that the library's AI-powered initiatives will have a positive long-term impact on my education.	1.32	2.63	10.53	39.47	46.05	85.53	21.20

Five-point Likert scale ranging Strongly Disagree – Strongly Agree

*The vibrancy of the Learning Hub post-AI implementation (Q5)*

The item with the lowest mean score is No. 12 "Library is a more lively learning area since AI-based services were put in place" (Mean = 3.59). This is indicative of a relatively less positive reaction than for other aspects of the impact AI will supposedly have. The lower score may reflect the difference in perception of functional benefits versus less tangible or cultural shifts necessary to



make a library feel "vibrant." Whilst AI facilitates efficient services, it may not promote a stronger sense of community or active engagement in the way that human interaction can (Huang et al., 2024). When, as is often the case, AI is considered as an 'instrument' to gather information, rather than an instrument to reinforce community ties, libraries, as traditional centers of learning and local community interaction over information, will take a longer while or a greater effort to adapt to vibrant life as AI-enriched learning environments (Garoufali & Garoufallou, 2024).

#### *Improvements in Search Capabilities (Q2)*

I have seen improvements in my searching ability for AI-based library services (3.84) is still being a rather positive evaluation, this is significantly lower than other constructs such as user engagement or satisfaction. Expected reason of relatively low score might be that despite the efficiency of AI-based search engines, they are constrained from addressing super specific and nuanced queries/signals or different types of data. It may also have something to do with user expertise with such systems: users with less experience with AI-based search may be less sensitized to what it does (Isiaka et al., 2024). The AI system being too complex and taking too long to learn could explain at least why there are only moderate reported increases in capacity to search (Pan & Xue, 2023). All in all, the findings provide strong empirical evidence for the positive effects of AI on engagement, skill development, and accessibility, but also point to the areas for further improvement.

#### **Findings of the study**

The results of the study explore the range of user services that incorporate the use of AI technologies in academic libraries all over Pakistan and extents to which Students are aware and satisfied with these technologies. It further interrogates the potential of these technologies in the education sector in the future. The outcomes gloomed that certain number of university libraries in Pakistan have adopted and implemented limited AI based services such as text to speech and speech to text, usage of google assistant to voice command search, and exercise of intelligent data analysis in collection development. These results are in line with the previous studies results (Ali 2021; Jabeen, 2024). Despite the implementation of these types of AI services, there has not been any case reported of a university library that has implemented an all-encompassing range of AI based services. Natural language understanding, voice search, and Chatbots are the technologies most familiar to and used centrally by students (Donkor & Afrane, 2023). The potential of AI in Pakistani education maybe encouraging but there are challenges that need to be addressed. One of them is the limited use of AI technology because of the exorbitant price tag and lack of necessary infrastructure. In most cases, students were worried about AI technology as being too advanced and giving less human approaches than before towards practical learning. Similarly, ethical issues related to the privacy of data, the security of data and any possible bias within the AI systems should be closely controlled and legislated (Nazir, 2023). Despite these challenges, Pakistan education leaders and policy makers see AI transforming education in Pakistan for the better.

Like other educational institutions in the world, academic libraries in Pakistan are also under pressure to find ways to improve Students' participation in learning using AI technology. Striking a balance between the adoption of AI technologies and these preferences will be essential in creating a dynamic and flexible learning environment. Academic libraries can make great efforts for the future of students and improve educational outcomes by adopting and modifying artificial intelligence educational practices and services that are practiced in other neighboring countries

(Balalaieva, 2023; Shoukat, 2024)). In addition, Pakistani universities and colleges can leverage AI based technologies in library networks with an opportunity to apply these technologies in providing information services (Jabeen, 2024).

### **Practical and theoretical Implications**

The results of the study carry profound implications in Pakistan's education in general and society in particular. The implementation of AI-based individualized instructions that help Students to become engaged, develop skills, and be more inclusive in the learning process, indicates ways of advancing education in academic libraries. The traditional approach of the libraries as collections of books can be transformed through the addition of AI technologies allowing for people-centered approaches and encouraging the reduction of inequality by improving educational opportunities (Chavan & Naikar, 2024). The encouraging response of Students towards AI-based programs provides a window of opportunity in introducing changes that draw investment towards artificial intelligence devices. This shift will not only revive libraries as places of education but also make them learning centers that encourage the acquisition of knowledge and skills throughout one's life thus raising the education standards and providing a fully brainwashed workforce.

The study adds to the existing learning on the application of AI technologies in the educational ecosystem including the utilization of these technologies in academic libraries in the developing nations such as Pakistan. It also helps assess AI acceptance, including students' view as well as how these technological processes may benefit education in the long run. The results emphasize that AI acceptance cannot be fully understood without knowledge about the user, the technology and how technology is assimilated in the learning process. Therefore, it provides a basis for further exploration of the impact of AI on education and library domains in future studies. Furthermore, this study also points out the productivity of AI and the necessity of expanding the personalization of its use in conjunction with the traditional methods of learning.

### **Limitations of the study and prospects**

The research is confined by virtue of the existing AI services offered within academic libraries of Pakistan, geographic scope, and use of self-administered questionnaires with a relatively small pool of students. Therefore, future research should explore the emerging AI services including broader perspective and larger population.

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