Journal of Media Horizons
ISSN: 2710-4060 2710-4052 Volume 7, Issue 5, 2026

ARTIFICIAL INTELLIGENCE ADOPTION IN HIGHER EDUCATION OF PAKISTAN: AWARENESS, PERCEPTIONS, USE, AND CHALLENGES AMONG UNIVERSITY TEACHERS IN KHYBER PAKHTUNKHWA

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DOI: https://doi.org/10.5281/zenodo.20051298

Keywords
Artificial Intelligence, Teacher Perceptions, Challenges, Higher Education, Khyber Pakhtunkhwa, Pakistan

Article History
Received: 11 March 2026
Accepted: 21 April 2026
Published: 06 May 2026

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Abstract
The purpose of this study is to examine the adoption of Artificial Intelligence (AI) in higher education, focusing on the awareness, perceptions, use, and challenges among university teachers in Khyber Pakhtunkhwa, Pakistan. This study applied survey research design and quantitative research approach, using questionnaire as a tool. The data were collected from university teachers in Khyber Pakhtunkhwa (KPK). The questionnaire was emailed to faculty members across all universities of KPK and used convenient sample techniques. Descriptive statistics techniques and SPSS tools were used for data analysis. The findings reveal that most of the respondents were moderately familiar with AI technologies and very lest (4.3%) were extremely familiar. Majority of university teachers generally perceived that application of AI technologies have positively impact on education and beneficial for teachers and students. ChatGPT is the most widely used AI tool, with 79.7%, while other AI tools such as Chatbots, Pi, plagiarism detection software, adaptive learning platforms, Gemini , DeepSeek, and AI-powered grading systems were minimally adopted. In addition, applications of AI technologies enhance access to resources; improve personalized learning, and efficiency in grading. As for as challenges are concerned, respondents' perceived that lack of AI training was the high challenge and ethical concerns, reliability issues, and resistance to change were the least one. These findings provide valuable insights for policymakers, institutions, and educators aiming to modernize educational practices.

1. INTRODUCTION

Artificial Intelligence (AI) is transforming education by facilitating adaptive learning, creating intelligent tutoring systems, and developing effective assessment techniques. It fosters personalized learning experiences and enhances student engagement through insights derived from data (Miao & Holmes, 2021). Worldwide, higher education institutions are progressively incorporating AI to improve teaching, research, and administrative processes. These technologies assist educators by automating repetitive tasks and promoting student-centered methodologies (Zawacki-Richter et al., 2019; Holmes, 2020). Nonetheless, obstacles such as ethical dilemmas, concerns

regarding data privacy, and disparities in access continue to impede broad implementation. In developing areas, the adoption of these technologies remains slow due to insufficient resources and infrastructure (Holmes et al., 2019; Iqbal et al., 2025). Artificial Intelligence (AI) adoption within higher education in Pakistan is steadily on the rise, as universities begin to investigate AI tools for purposes such as teaching, research, and administrative functions. There is an increasing awareness among faculty, particularly concerning applications like automated assessment and content creation. Nonetheless, the extent of adoption is still restricted due to insufficient infrastructure, a lack of technical expertise, and financial limitations (Khurshid et al., 2024). It is crucial for policy support from organizations like the Higher Education Commission of Pakistan to facilitate broader implementation (HEC, 2020; Mah & Groß, 2024).

University teachers play a central role in AI integration in Pakistan by adopting innovative pedagogies and incorporating AI tools into teaching and assessment practices. Their awareness, skills, and attitudes significantly influence successful implementation. However, limited training opportunities and technological support hinder effective use. Capacity-building initiatives led by institutions and the Higher Education Commission of Pakistan are essential to empower teachers for meaningful AI integration (HEC, 2020; Ullaha et al., 2024). University teachers in Pakistan are gradually becoming more aware of and using AI technology, with many of them using tools for lesson preparation, material development, and individualized learning (Ahmed et al., 2024). Teachers' opinions and perceptions of AI are typically positive, acknowledging its practicality and simplicity of integration in the classroom (Bibi et al., 2025). Adaptive learning systems and automated assessment procedures are examples of AI applications that improve the efficacy of instruction (Basit et al., 2024). However, obstacles like poor infrastructure, a lack of training, and resource limitations prevent widespread use (Qayyum et al., 2024; Tago et al., 2025).

1.1 Research Gap and Rationale

Although global literature highlights the rapid transformation of higher education through Artificial Intelligence (AI), there is still limited empirical evidence on how university teachers in Pakistan, particularly in Khyber Pakhtunkhwa (KP), are engaging with AI in real academic settings. Existing Pakistani studies have mainly focused on general adoption trends, digital readiness, or student perspectives, while context-specific investigations into teachers' awareness, perceptions, and classroom-level applications remain scarce. Research from KP shows growing interest in digital tools and AI integration, yet also highlights uneven usage and institutional constraints such as inadequate training and infrastructure (Ismail et al., 2024; Khan et al., 2025; Naureen et al., 2025; Rahman et al., 2025; Sajjad et al., 2025). Similarly, recent studies indicate that although teachers in KP universities show positive attitudes toward AI, successful adoption is still hindered by technical and organizational barriers (Bahader, 2022; Ahmad et al., 2024; Ullah et al., 2025; Saboor et al. 2025; Bibi et al., 2025). Furthermore, most available studies in Pakistan emphasize broad national or cross-provincial samples rather than focusing specifically on KP universities, where educational resources and technological readiness differ significantly from major urban centers. There is also a lack of comprehensive research that simultaneously examines awareness, perceptions, actual pedagogical applications, and challenges within a single framework. Therefore, this study is necessary to fill this gap by providing an integrated understanding of AI adoption among university teachers in Khyber Pakhtunkhwa. The findings will support policy development, capacity building, and strategic planning for effective AI integration in higher education institutions.

1.2 Research Questions

This study focus to answer the following research questions:

1. What is the level of awareness of university teachers about artificial intelligence (AI) technologies in education?
2. What types of AI tools are used by university teachers in their teaching practices?
3. What are university teachers' perceptions of AI technologies in education?
4. What benefits do university teachers see in using AI in higher education?
5. What challenges do university teachers face when adopting AI technologies in higher education?

2. Literature Review

2.1 Artificial Intelligence: Concept and Meaning

Artificial intelligence (AI) is a discipline of computer science that focuses on creating systems and machines capable of doing activities that normally require human intelligence. These tasks include data-driven learning, reasoning, problem solving, language comprehension, and decision-making. Artificial intelligence systems replicate human cognitive functions using technologies such as machine learning, natural language processing, and neural networks. J. McCarthy, an American computer scientist, initially introduced the name "Artificial Intelligence" (AI) during an academic conference on AI held in 1956. Minsky, K. Shannon, N. Rochester, and other scholars acknowledged the agreement to approve the new name for this discipline and agreed on the above word (McCarthy et al., 2006). Artificial Intelligence is a mathematical model with learning capabilities that was developed in accordance with the human brain (Doroganov & Baumgarten, 2013). According to L.S. Bolotova, AI is a type of artificial computer system capable of simulating human intelligence: such a system can receive, analyze, and store information and knowledge, as well as perform various actions on it that resemble thinking (Bolotova 2012). In addition, artificial intelligence (AI) is a discipline of computer science that focuses on creating systems and machines capable of doing activities that normally require human intelligence. These tasks include data-driven learning, reasoning, problem solving, language comprehension, and decision-making. Artificial intelligence systems replicate human cognitive functions using technologies such as machine learning, natural language processing, and neural networks (Begishev et al., 2020).

2.2 Evolution of Artificial Intelligence in Higher Education

The development of Artificial Intelligence (AI) in higher education has evolved through multiple phases, starting with simple computer-assisted instruction and advancing to sophisticated intelligent learning systems. The application of artificial intelligence in education dates back to the 1970s, when young students were introduced to LOGO programming and turtle robots. However, those technologies emphasized computational reasoning or programming ideas rather than AI. According to Russell and Norvig (1995), computer science students may study how AI solves problems, reason, learns, makes decisions, communicates, perceives and acts. However, the concept was limited to the field of computer science itself. Later, the notion of AI in education evolved to include the integration of AI into the education management system, which facilitates teaching, learning, and decision-making while also offering virtual assistance for personalized education (Dignum, 2021; Hwang et al., 2020). AI can offer personalized learning for pupils, facilitating their learning needs. AI-based technologies, such as cloud computing, can help educators deliver learning content to students in a format that meets their needs (Kabudi, Pappas, and Olsen, 2021). Additionally, Chatbots can help students learn more effectively and independently (Chen et al., 2020). The role of AI in education is on the rise, as evidenced by global initiatives e.g., ISTE, UNESCO, DigComp that have begun to conceptualize AI education in accordance with the most recent educational standards and design guidelines to address digital literacy levels worldwide (Riina et al., 2022; Sinha, 2022; Miao & Shiohira, 2021).

2.3 Artificial Intelligence Adoption in Higher Education in Pakistan

Artificial intelligence (AI) use in higher education in Pakistan is rapidly rising, with universities investigating its possibilities in teaching, learning, and administration. According to studies, AI techniques such as adaptive learning systems and automated assessments are gradually being integrated into academic practices in order to improve student performance and individualized learning experiences (Basit et al, 2024). According to research, both instructors and students have a positive attitude about AI adoption, acknowledging its potential to improve educational outcomes (Mirza et al., 2025). However, acceptance levels remain varied across institutions, particularly in urban and resource-constrained locations. Empirical studies indicate important limitations such as limited technology infrastructure, technical skills, and insufficient institutional support (Tago et al., 2025). Furthermore, institutional preparation and policy frameworks are still being developed, which has an impact on the successful application of AI in universities (Huma et al., 2024). In Khyber Pakhtunkhwa, research indicates that, while AI use is increasing in public and private universities, its practical application is still in its early stages due to resource disparities and digital preparedness (Khan et al., 2025). As a result, while AI has the potential to improve higher education in Pakistan, its successful implementation hinges on addressing infrastructural, pedagogical, and policy-related issues.

2.4 Artificial Intelligence Adoption in Universities of Khyber Pakhtunkhwa: Awareness, Perceptions, Use, and Challenges

The implementation of artificial intelligence (AI) in universities in Khyber Pakhtunkhwa (KP), Pakistan, is progressively expanding, with teachers becoming more aware of AI tools and their pedagogical potential. According to studies, many university teachers are familiar with AI applications and understand its value in boosting teaching efficiency, developing instructional materials, and improving evaluation processes (Bibi et al., 2025). However, the level of awareness and practical application varies with institutional support and individual competencies. In terms of perceptions, teachers at KP are largely supportive about AI integration. According to research, teachers feel AI promotes individualized learning, increases content quality, and allows for quick feedback and evaluation (Khan et al., 2025). Similarly, comparative studies conducted at KP universities show that perceived utility and simplicity of use have a substantial influence on educators' adoption of AI technology (Basit et al., 2024).

AI technologies are increasingly being used in educational processes such as lesson preparation, content development, adaptive learning, and automated assessment. AI tools also help with research and administrative work, resulting in enhanced academic achievement and efficiency (Ali & Usman, 2023). However, the level of utilization varies between institutions, with public universities frequently falling behind private ones due to resource constraints. Despite these advances, various obstacles prevent effective AI deployment in KP universities. Key constraints include inadequate technological infrastructure, a lack of professional training, faculty AI literacy, and insufficient institutional support. Studies also highlight difficulties like the digital gap, resistance to change, and concerns about over-reliance on AI tools (Naveed et al., 2025). As a result, while AI deployment in KP is increasing, overcoming these difficulties is critical for its effective and long-term incorporation into higher education. According to Ismail and Haseeb (2024) study, there is a favorable trend in AI literacy among library professionals about artificial intelligence and its application in libraries. The study participants were clearly enthusiastic about the potential of AI and believe that it has the ability to change university library services. The study also identified significant challenges and issues that librarians faced when implementing AI applications, including inadequate IT infrastructure and a lack of funds, copyright issues, a lack of interest from higher authorities, and a lack of interest from staff, which emerged as the most pressing concerns.

Other serious issues raised by respondents included a shortage of competent library staff and a lack of institutional policy. The study results of Khan et al., (2025) shows that people are becoming more conscious of AI tools including recommendation structures, computer-generated reference facilities, and intelligent exploration engines. On the other hand, low money, lack of institutional strategies, lack of technical skills, and inadequate infrastructure all contribute to limited implementation. Development is further hampered by worries about data confidentiality and profession displacement. According to Naureen et al. (2025), librarians see AI as a revolutionary tool, particularly for data-driven decision-making, research support, and service development. However, opinions were divided on AI's compatibility with library principles and its function in everyday jobs such as cataloguing. Confidence in AI's practical applications varies, indicating the need for increased awareness and training. Poor IT infrastructure, inconsistent power supply, and high expenses were among the primary implementation obstacles. While overcoming obstacles was widely recognized as critical, perceptions on leadership support and staff preparedness varied among institutions. According to Bahader (2022) study, significant obstacles to CRM services include financial resources/budget, qualified, experienced, and trained staff, human resource satisfaction and motivation, information technology infrastructure, CRM knowledge and understanding by staff, library culture and collaboration, library users, and leadership commitment. Ullah et al., (2025) conducted a comprehensive literature review and analysis of existing industry practices to demonstrate how AI-driven solutions such as chatbots, predictive analytics, and resume screening algorithms are altering HR roles. While AI has many advantages, like time savings and better candidate-job matching, it also raises serious concerns about data privacy, algorithmic bias, and ethical transparency.

2.5 Conclusions

In conclusion, the examined literature reveals that the use of Artificial Intelligence (AI) in higher education is progressively increasing in Pakistan; however, it is still in its early stages and is uneven. Existing research shows that university teachers have good opinions and are willing to incorporate AI into their teaching and academic practices, particularly because of its potential to improve instructional efficiency, content development, and student engagement (Bibi et al., 2025). At the same time, research shows that AI awareness, supportive conditions, and perceived hazards have a substantial impact on educators' attitudes and behavioral intentions towards AI adoption. Despite these optimistic developments, some ongoing hurdles impede effective implementation, including low institutional preparation, a lack of formal training, inadequate infrastructure, and a lack of defined legislative frameworks (Huma et al., 2025). Studies undertaken in several regions of Pakistan highlight discrepancies in access to technical resources and professional development opportunities, particularly in underdeveloped or rural areas (Tago et al., 2025). Furthermore, concerns about ethical use, academic integrity, and overreliance on AI tools continue to influence educators' cautious attitudes. In Khyber Pakhtunkhwa, empirical evidence suggests that, while teachers have positive perceptions and self-efficacy about AI use, structured support systems and targeted capacity-building initiatives are still required to ensure meaningful and responsible integration (Bibi et al., 2025). Overall, the literature shows that AI uptake in Pakistani higher education is driven by a complex interaction of awareness, perceptions, usage patterns, and contextual factors. However, there is still a significant gap in region-specific and thorough research on university professors' experiences, notably in Khyber Pakhtunkhwa. As a result, the purpose of this study is to address this gap by providing empirical insights into university teachers' awareness, perceptions, usage, and challenges related to AI adoption, thereby contributing to the development of contextually

relevant policies and strategies for effective AI integration in Pakistani higher education.

3. Research Methodology

This study applied quantitative research approach and used survey research design. This design was successfully used in the studies conducted in library and information science by (Bahader et al., 2024; Bahader, 2023; Bahader et al., 2021; Bahader et al., 2020). This study is descriptive in nature to with the aim to study the artificial intelligence adoption in higher education in Khyber Pakhtunkha, Pakistan. This study also addresses the awareness, perceptions, use, and challenges among university teachers. A questionnaire was used for the collection of data. The questionnaire was developed after systematic analysis of the literature to understand the implications of the research. Level of awareness, different AI technologies used in education, perceptions regarding of AI technologies, perceived benefits of AI in education, and challenges variables were studied. The questionnaire contain tow units, the first unit contain demographic data regarding responding age, gender, job experience, academic qualification, and designation respectively. The second unit contains information about the variables that is awareness, perceptions, use, and challenges among university teachers of Khyber Pakhtunkhwa. To measure awareness, use, and challenges of AI technologies "Yes" and "No" scale, while for perceptions and benefits of AI technologies, five-point, Likert Scale with the following anchors: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree were used.

The study population contained all faculty members including lecturers, assistant professors, associate professors, and professors of public and private sector universities and degree awarding institutes of Khyber Pakhtunkhwa (KPK). The total universities are 42 in KPK including public and private sectors, and degree awarding institutes recognized by Higher Education Commission (HEC) of Pakistan. Date was collected from faculty members through convenient sampling techniques.

The questionnaire was sent online through email and social media groups to all respondents. Primarily the reply rate was small. Though, after continuous efforts and follow up tactics the responses were increased and 984 respondents were replied respectively. The collected date was updated, cleaned, and coded. The Statistical Package for the Social Sciences (SPSS) software version 23 was used for data analysis. Descriptive statistics (frequency, percentage, mean) were applied to find the results and the same techniques of data analysis were used by (Bahader et al., 2025; Khan et al., 2024). All research protocols adhered to ethical standards. Participation was voluntary, and confidentiality was maintained throughout the study. Respondents were assured that their data would be used solely for academic purposes.

4. Results

4.1 Demographic Data of Respondents

The respondents' age, gender, job experiences, academic qualification, and designation is given in the table 1 and the details are as under:

There were 984 respondents and majority of participants fall within the 30–40 years age group (46.7%), ranking first, followed by those aged 40–50 years (27.8%), ranked second. Respondents aged 50–60 years constitute 13.6% of the sample, ranking third, while participants under 30 years account for 10.2%, ranking fourth. The smallest proportion of respondents belongs to the over 60 year's age group (1.6%), ranked fifth. Overall, the data indicate that most respondents are within the economically active and professionally engaged age brackets. The gender-wise distribution of the respondents shows that male participants constitute the majority of the sample, accounting for 73.0% of the respondents, while 27.0% are female. This indicates a higher representation of male respondents in the study, which may reflect the gender composition of enrolment in the selected learning context. According to job experience, the largest proportion of participants has 5–10 years of job experience (37.4%), ranking first, followed by those with 11–20 years of experience (32.6%), ranked second. Respondents with less than 5

years of experience constitute 15.2% and rank third, while those with more than 20 years of experience represent 14.7% of the sample, ranking fourth. Overall, the findings indicate that most respondents possess moderate to substantial professional experience. In additions, academic qualifications of the respondents, majority hold an M. Phil degree (39.6%), ranking first, followed by those with a PhD (35.8%), ranked second. Respondents with M.A/BS qualifications account for 23.3% of the sample and rank third, while a small proportion has completed postdoctoral studies (1.3%), ranking fourth. Overall, the data indicate a highly qualified respondent group, with most participants holding advanced postgraduate degrees. As for as designation of the respondents is concern, lecturers constitute the largest group, accounting for 46.0% of the sample and ranking first, followed by Assistant Professors at 42.0%, ranked second. Associate Professors represent 10.4% of the respondents, ranking third, while Professors form the smallest group at 1.6%, ranked fourth. Overall, the distribution indicates that the majority of participants occupy early to mid-career academic positions.

Table 1
Demographic Data of Respondents (N=984)

Variables	Percentage (%)	Rank
Age		
Under 30	10.2 %	4
30-40	46.7%	1
40-50	27.8%	2
50-60	13.6%	3
Over 60	1.6%	5
Gender		
Male	73.0%	1
Female	27.0%	2
Job Experiences		
Less than 5 years	15.2%	3
5-10 years	37.4%	1
11-20 years	32.6%	2
Above 20 years	14.7%	4
Academic Qualification		
M.A/BS	23.3%	3
M.Phil	39.6%	1
PhD	35.8%	2
Post Doc	1.3%	4
Designation		
Lecturer	46.0%	1
Assistant Professor	42.0%	2
Associate Professor	10.4%	3
Professor	1.6%	4

4.2 Level of Awareness (RQ1)

The table 2 illustrates respondents' levels of awareness of AI technologies. The largest proportion of participants reported being moderately familiar with AI technologies (45.6%) ranking first. This is followed by those who are slightly familiar (26.8%), ranked second, and very familiar respondents (19.2%), ranked third. A smaller percentage indicated being extremely familiar (4.3%) or not at all familiar (4.1%), ranking fourth and fifth, respectively. Overall, the findings suggest a moderate level of awareness of

AI technologies among the majority of respondents.

Table 2
Level of Awareness (N=984)

How familiar are you with AI technologies	Yes Percent (%)	Rank
Moderately familiar	45.6 (%)	1
Slightly familiar	26.8(%)	2
Very familiar	19.2(%)	3
Extremely familiar	4.3(%)	4
Not at all familiar	4.1(%)	5

Scale: 1= Yes, 2= No

4.3 Use of AI-Powered Tools in Education (RQ2)

The table 3 presents respondents' use of various AI technologies in education. ChatGPT is the most widely used tool, with 79.7% of respondents reporting usage, ranking first. This is followed by general Chatbots (12.3%), ranked second, and Pi (4.6%), ranked third. Usage of plagiarism detection software (4.2%), adaptive learning platforms (2.1%), Gemini (2.0%), and DeepSeek (1.2%) remains limited. AI-powered grading tools show the lowest usage rate at 0.4%, ranking last. Overall, the findings indicate a strong reliance on ChatGPT, while the adoption of other AI-driven educational tools is minimal.

Table 3
Use of AI-Powered Tools in Education (N=984)

Types of AI-Powered Tools Used in Education	Yes Percent (%)	Rank
ChatGPT	79.7 (%)	1
Chatbots	12.3 (%)	2
Pi	4.6 (%)	3
Plagiarism detection software	4.2 (%)	4
Adaptive learning platforms	2.1(%)	5
Gemini	2.0(%)	6
DeepSeek	1.2(%)	7
AI-powered grading tools	.4(%)	8

Scale: 1=Yes, 2=No

4.4 Perceptions of AI Technologies (RQ3)

The table 4 presents respondents' perceptions of AI technologies in education based on mean scores and standard deviations. The highest-ranked statement indicates that AI tools should be integrated into university education (M = 3.66, SD = 1.014), reflecting strong agreement. This is closely followed by perceptions that AI can improve student engagement and learning outcomes (M = 3.65, SD = 0.985) and reduce the workload of university teachers (M = 3.65, SD = 0.928). Concerns regarding the ethical implications of AI use also received a relatively high mean score (M = 3.62, SD = 0.949). Respondents reported moderate confidence in using AI technologies for teaching (M = 3.59, SD = 0.822). Lower mean scores were observed for perceptions that AI threatens the role of educators (M = 3.31, SD = 0.898) and that AI can enhance the quality of teaching and learning (M = 3.00, SD = 1.279). Overall, the results suggest generally positive attitudes toward AI integration, accompanied by ethical concerns.

Table 4
Perceptions of AI Technologies (N=984)

Perceptions Statements	Mean	SD	Rank
AI tools should be integrated into university education	3.66	1.014	1
AI can improve student engagement and learning outcomes	3.65	.985	2
AI can help reduce the workload of university teachers	3.65	.928	3
AI can enhance the quality of teaching and learning	3.62	.949	4
I feel confident in using AI technologies for teaching	3.59	.822	5
AI threatens the role of educators	3.40	.898	6
AI may lead to increased reliance on technology	3.35	.980	7
The use of AI in education raises ethical concerns	3.00	1.279	8

Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

4.5 Perceived Benefits of AI Technologies in Education (RQ4)

The table 5 illustrates respondents' perceptions of the benefits of AI in education. Student engagement is ranked as the most significant benefit (M = 1.99, SD = 0.063), followed by efficiency in grading (M = 1.86, SD = 0.340) and personalized learning (M = 1.84, SD = 0.357). Improved access to learning resources received the lowest mean score (M = 1.28, SD = 0.452), ranking fourth. Overall, the findings indicate that respondents primarily associate AI use in education with enhanced engagement and instructional efficiency.

Table 5
Perceived Benefits of AI Technologies in Education (N=984)

Application of AI in Education enhance....	Mean	SD	Rank
Improved access to resources	1.99	.063	1
Personalized learning	1.86	.340	2
Efficiency in grading	1.84	.357	3
Student engagement and motivation	1.28	.452	4

Scale: 1= Yes, 2= No

4.6 Challenges

The table 6 presents respondents' perceived challenges in adopting AI technologies in education. The most frequently reported challenge is a lack of AI training, identified by 71.2% of respondents, ranking first. This is followed by ethical concerns (15.0%), ranked second, and reliability issues (13.4%), ranked third. Resistance to change among faculty was reported by a very small proportion of respondents (0.4%), ranking fourth. Overall, the findings suggest that insufficient training is the primary barrier to effective AI integration, while other challenges are perceived as less significant.

Table 6
Challenges in the Adoption AI Technologies in Education (N=984)

Challenges	Yes Percentage (%)	Rank
Lack of AI training	71.2 (%)	1
Ethical concerns	15.0 (%)	2
Reliability issues	13.4 (%)	3
Resistance to change among faculty	.4 (%)	4

Scale: 1= Yes, 2= No

5. Discussion

The findings of this study reveal that Artificial Intelligence (AI) is gradually transforming higher education in Khyber Pakhtunkhwa (KP), Pakistan, by offering new opportunities for personalized learning, intelligent tutoring, and data-driven decision-making (Cantú-Ortiz et al., 2020; UNESCO, 2021). University teachers reported moderate familiarity with AI technologies, indicating growing awareness but highlighting the need for targeted professional development. ChatGPT emerged as the most widely used AI tool, with 79.7% of respondents utilizing it for teaching, whereas the adoption of other AI-driven applications, such as DeepSeek, adaptive learning platforms, and AI-powered grading tools, remained minimal. This pattern suggests that accessible, user-friendly AI tools are more rapidly integrated than complex or resource-intensive systems (Zawacki-Richter et al., 2019; Espejel et al., 2023). Teachers generally perceived AI positively, acknowledging it's potential to enhance student engagement, improve learning outcomes, and reduce workload; yet ethical concerns and the perceived threat to educators' roles remain significant considerations. Student engagement, personalized learning, and grading efficiency were identified as the primary benefits of AI use, while lack of training, reliability issues, and ethical challenges were the main barriers. These findings align with global research indicating that insufficient training, limited infrastructure, and uneven familiarity constrain AI adoption in developing regions (Qayyum et al., 2024; Ullah et al., 2025). The data also suggest that faculty members are generally open to AI integration, provided there is adequate support and ethical guidance. Overall, AI presents a promising avenue for modernizing teaching and learning in KP universities, yet its successful implementation requires context-specific strategies, including professional development, infrastructural improvements, ethical frameworks, and integration into pedagogical practices. This study highlights the importance of understanding teachers' perspectives as key agents in AI adoption, as their engagement and capacity to utilize AI effectively directly influence the sustainability and meaningfulness of AI-supported education. The findings underscore that AI adoption is not solely a technological challenge but also a pedagogical and institutional one, requiring systemic efforts to ensure equitable and responsible integration. While generative AI tools like ChatGPT offer immediate benefits, advanced AI applications hold untapped potential for enhancing assessment, adaptive learning, and student-centered instruction. Future educational reforms must balance technological innovation with teacher training, ethical considerations, and inclusive access to ensure that AI positively impacts learning outcomes and professional development. These insights provide evidence for policymakers, educators, and institutional leaders to design targeted interventions that maximize AI's benefits while mitigating associated risks.

6. Conclusions and Recommendations

University teachers in KP demonstrate moderate awareness of AI technologies, with ChatGPT being the most widely adopted tool. AI is perceived as enhancing student engagement, learning outcomes, and instructional efficiency, although ethical concerns and professional role apprehensions persist. Lack of AI training is the most significant barrier, followed by reliability issues. The findings highlight the need for context-specific strategies to integrate AI effectively in higher education. Overall, AI presents significant opportunities for modernizing teaching and learning, provided adequate support, training, and infrastructure are in place.

Universities should implement structured AI training programs for faculty, focusing on pedagogical applications and ethical considerations. Clear guidelines and policies should be established to ensure responsible AI adoption. Investment in digital infrastructure is essential for equitable access to AI tools. AI should be systematically integrated into curriculum and teaching practices as well as in library services to enhance student engagement and personalized learning and services.

Continuous evaluation and sharing of best practices are recommended to sustain effective AI integration in higher education.

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