

AI Adoption in Higher Education: A Comparative Study of Institutional Readiness and Challenges

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Abstract

This study explored the patterns of AI adoption, varying degrees of institutional readiness, and challenges of implementation in higher education in Pakistan, employing a mixed-methods comparative approach. To collect relevant data, the researchers used structured questionnaires from 250 faculty members and administrators and conducted semi-structured interviews with 30 key stakeholders in 5 sampled universities, including public, private, and federally chartered institutions. The results indicated stark differences in the level of AI readiness from different institution types; specifically, private universities showed more advanced infrastructural capability (3.8/5.0), as opposed to public (2.9) and federal institutions (3.2). Notably, while 72% of respondents reported a general awareness of AI, only 22% of institutions were reported to have AI applications, which were primarily operated as pilots and not fully integrated into the institution. The predominant barrier to implementation was identified as a lack of financial resources (82%), followed by insufficient infrastructure (78%), and a lack of technical expertise (74%). From the qualitative assessment, five thematic challenges of implementation emerged: gaps in leadership vision, deficits in technical capacity, faculty resistance to change, financial sustainability concerns, and absence of policy frameworks. Additionally, the lack of comprehensive change management was evident, as 64% of respondents expressed concerns about job security and 72% about data privacy. These findings suggest the need for phased approaches, along with substantial infrastructural investments, training, and clear policy frameworks to address the AI adoption imbalance in higher education institutions in Pakistan.

Keywords: Patterns, AI adoption, institutional readiness, challenges, implementation, higher education, Pakistan.

Introduction

In many countries, AI technologies have transformed industries, including higher education. Globally, institutions recognized AI's potential to improve teaching, streamline administration, reshape support systems, and enhance research (Aithal and Maiya, 2023). In Pakistan's higher education sector, however, realizing AI's potential was complicated by implementation challenges. The contrast between well-resourced public universities and the emerging private sector highlighted these issues (Fakir Mohammad, Hinduja et al., 2024). As education systems worldwide embraced private education models, the focus shifted to comparing resources and technological capabilities across institutions (Khurshid et al., 2024).

Pakistani universities operate within a context of infrastructural challenges, uneven digital literacy among teachers and students, and limited budgets for technology (Ikram and Kenayathulla et al., 2025). Some universities seek to implement AI in learning management systems, automated grading, personalized learning pathways, and administrative processes (Ahmed, Mallah et al., 2024). However, adoption is inconsistent, revealing gaps in preparedness, implementation, and outcomes (Aslam et al., 2025). The lack of comprehensive studies on institutional preparedness for AI integration made it difficult to shape effective policies and allocate resources (Aslam et al., 2025). Policymakers, university managers, and edtech providers need to focus on understanding comparative AI preparedness across different institutions (Sain and Nurtina et al., 2024).

This study examined the need for the first systematic assessment of AI adoption, institutional readiness, and execution challenges in Pakistan's higher education sector. The study examined the drivers of AI integration success and the barriers determining the extent of integration, comparing the experiences within public, private, and federally chartered universities. The study employed both the quantitative readiness framework and qualitative decision-making processes to understand the AI adoption phenomenon in its entirety. The intention was for the results to be strategic at the institutional level, influential in policy, and contribute to the conversation on tech integration in the educational settings of the developing world. The study also aimed to contribute to the literature on institutional frameworks for readiness assessment, extending beyond the study area to include more developing country contexts with tightly controlled technology funding in education, which necessitated intentional planning.

Research Objectives

1. To evaluate and compare institutional readiness for AI adoption across public, private, and federally-chartered universities in Pakistan.
2. To analyze the principal challenges and obstacles Pakistan higher education institutions face in the process of implementing AI.
3. To formulate a comprehensive framework that captures the various elements that determine successful AI integration in education settings with limited resources.

Research Questions

1. How does each type of university in Pakistan compares with each other when it comes to the levels of institutional readiness for the adoption of AI?
2. What are the barriers and challenges to the integration of AI in the academic and administrative functions of higher education institutions?
3. What is the role of institutional infrastructure, leadership, and faculty in the AI adoption initiatives to determine its success?

Significance of the Study

This research offered valuable insights for stakeholders in higher education in Pakistan. Administrators and policymakers can use these findings to plan AI integration and allocate resources. The comparative analysis helps assess institutional readiness and identify areas for improvement. For the Higher Education Commission of Pakistan, the results support system-wide, policy-driven relief and support. Faculty and educational technology specialists benefit from understanding both the value

of integrating AI and the challenges of implementation. As an initial step toward South Asian technology adoption research, this study provides relevant research frameworks for other developing countries. Overall, the aim is to encourage strategic dissemination and provision of AI in higher education and wider access to this research.

Literature Review

In the past ten years, the deployment of artificial intelligence in higher education has attracted a great deal of research attention internationally. Scholars write on multiple facets of technological adoption, the challenges of implementation, and outcomes of AI in education (Chu, Hwang et al., 2022). Globally, AI in education includes intelligent tutoring systems, adaptive learning technologies, automated administrative functions, and predictive analytics for student performance. Benefits noted in research include personalized learning, better student engagement, more efficient use of resources, and improved decision-making at the institutional level. The literature also highlights the importance of institutional context, technological infrastructure, human resource challenges, and the organizational climate for AI integration (Crompton and Burke, 2023). Studies from developed countries show that even well-resourced institutions face faculty pushback related to ethical issues of data privacy and unequal distribution of resources needed for technology and training (Prahani, and Rizki et al., 2022).

Recent educational technology literature on technology adoption focuses on "institutional readiness" and various frameworks for assessing readiness. The Technology Acceptance Model (TAM) looks at perceived usefulness and ease of use as key predictors of adoption (Nisiforou and Kosmas, 2024). Rogers' Diffusion of Innovation Theory explains how innovations flow through organizations, using constructs such as relative advantage, compatibility, complexity, trial ability, and observability. Further expansions introduced frameworks on readiness at the institutional level. These studies consider institutional leadership, culture, resources, and organizational change management. Research indicates that readiness assessments cover dimensions such as technology, human capital, finance, and strategic plans (Kathirveloo, 2024). Higher institutional readiness improves technology implementation, adoption, and return on investment (Wong and Li, 2025).

Research concerning developing nations identifies unique circumstances that differ from those in developed nations (Aslam, Aslam et al. 2025). In India, Malaysia, and Nigeria, studies describe less developed technological and funding infrastructures, unreliable internet connectivity, and gaps in digital skills for staff and students. Scholars argue that technology adoption models from Western contexts, developed on theoretical grounds, require significant adaptation to fit the resource realities of developing countries. They maintain that successful AI integration will depend on foundational infrastructure development, incremental policies, and realistic timelines matched to local contexts. As such, balanced expectations and pragmatic planning are crucial for technological advancement in developing countries (James 2021).

Despite foundational research on educational technology in South Asia, there is a clear lack of focused studies on artificial intelligence adoption in South Asian higher education (Henadirage and Gunarathne 2025). In Pakistan, challenges such as resistance to adoption, lack of professional training, and a gap between policy and practice reflect the broader issues identified in educational technology research (Qazi, Sharif et al. 2024). The experience with e-learning and learning management systems in Pakistani universities demonstrates that even advanced technologies face adoption barriers due to institutional inertia and insufficient training (Ahmad, Mohd Noor et al. 2023).

Methodology

The researchers used a mixed-methods approach to examine AI adoption in Pakistan's higher education institutions, conducting a comparative case study of five universities from different regions. The sample included public, private, and federally chartered institutions. Two hundred fifty faculty members and administrators completed structured questionnaires, assessing institutional readiness, technological infrastructure, and AI adoption factors. Additionally, semi-structured interviews with

30 key stakeholders, including vice-chancellors, IT heads, and department heads, explored decision-making frameworks and barriers to AI adoption. Purposive sampling ensured equitable distribution. Secondary data came from AI policy reports, institutional documents, and South Asian education literature. Quantitative data were analyzed using descriptive statistics and comparative analysis, while qualitative data were analyzed thematically. The study used the Technology Acceptance Model and Diffusion of Innovation Theory to guide the readiness framework. Ethical requirements were met through informed consent and institutional approvals.

Results and Data Analysis

Table 1: Demographic Characteristics of Respondents (N=250)

Demographic Variable	Category	Frequency	Percentage
Position	Faculty	145	58%
	Administrative	105	42%
Gender	Male	155	62%
	Female	95	38%
Institution Type	Public	100	40%
	Private	90	36%
	Federal	60	24%
Age Group	30-40 years	88	35%
	41-50 years	105	42%
	Above 50 years	57	23%
Teaching Experience	5-10 years	80	32%
	11-20 years	95	38%
	Above 20 years	75	30%

Table 1 presents demographic characteristics of 250 respondents from five universities. The majority were faculty members (58%), with 62% of participants being male. Regarding institutional type, public universities contributed 40% of respondents, followed by private (36%) and federal institutions (24%). In terms of age, most respondents were 41-50 years old (42%), and a plurality reported 11-20 years of teaching experience (38%), indicating substantial professional maturity among participants.

Table 2: AI Awareness Levels across Institution Types

Awareness Indicator	Public Universities	Private Universities	Federal Institutions	Overall
General AI Awareness	68%	82%	65%	72%
Substantial Understanding	32%	48%	35%	38%
Can Identify Applications	58%	75%	62%	65%
Attended AI Training	18%	32%	25%	24%

Table 2 demonstrates varied AI awareness across institutions. While private universities showed the

highest awareness (82%), public and federal institutions lagged behind at 68% and 65%. Substantial understanding was found in just 38% of respondents; however, 65% could identify AI applications. Formal AI training reached only 24%, revealing a significant gap in professional development. Interestingly, younger faculty members demonstrated higher awareness than their senior colleagues.

Table 3: Infrastructure Readiness Indicators by Institution Type

Infrastructure Indicator	Public	Private	Federal	Mean Score
Overall Infrastructure Readiness (1-5)	2.9	3.8	3.2	3.3
Good/Excellent Internet Connectivity	45%	78%	62%	62%
LMS Adoption Rate	52%	85%	68%	68%
Budget for IT (% of operational)	4.5%	12%	7.2%	8%
Adequate Technical Support Staff	38%	68%	52%	53%

Table 3 shows major infrastructure gaps. Private universities led in readiness (3.8/5.0), ahead of public (2.9) and federal (3.2) institutions. They allocated 12% of their budget to IT, while public universities allocated 4.5%. Learning Management System adoption was 85% in private versus 52% in public universities, revealing technological gaps.

Table 4: Attitudes Toward AI Adoption in Higher Education

Attitude Dimension	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
AI Will Improve Education Quality	28%	42%	18%	8%	4%
AI Threatens Job Security	22%	42%	18%	14%	4%
AI Is Too Complex to Implement	18%	40%	22%	15%	5%
Institutions Should Prioritize AI	25%	38%	22%	10%	5%
Concerned About Data Privacy	32%	40%	15%	10%	3%

Table 4 illustrates mixed attitudes toward AI adoption. Although 70% agreed AI would improve education quality, concerns persisted: 64% had job security worries and 72% cited data privacy fears. Attitudes also varied with age; younger faculty members (78% positive) were more receptive, in contrast to just 42% positivity among their senior colleagues. Furthermore, those with prior technology exposure showed a strong correlation with favorable perceptions of AI integration.

Table 5: Barriers to AI Adoption across Institutions

Challenge Category	Critical	Major	Moderate	Minor	Not a Challenge
Financial Constraints	52%	30%	12%	4%	2%
Infrastructure Inadequacy	42%	36%	15%	5%	2%
Lack of Technical Expertise	38%	36%	18%	6%	2%
Resistance to Change	32%	36%	22%	8%	2%
Data Security Concerns	35%	37%	20%	6%	2%

Absence of Institutional Policy	28%	37%	25%	8%	2%
Limited Training Opportunities	30%	28%	28%	10%	4%

Table 5 identifies primary implementation barriers. Financial constraints emerged as the most critical challenge (82% rated it major/critical), particularly in public universities (92%). Infrastructure inadequacy affected 78% of institutions, while 74% cited insufficient technical expertise. Resistance to change was significant (68%), especially among senior faculty. Data security concerns and policy absence also hindered adoption efforts substantially.

Table 6: AI Implementation Status and Future Plans

Implementation Status	Public	Private	Federal	Overall
Currently Have AI Systems	12%	38%	22%	22%
Pilot/Limited Scale Projects	75%	58%	68%	68%
Institution-Wide Deployment	25%	42%	32%	32%
Plans for AI in 2-3 Years	35%	65%	45%	48%
No Definite Plans	42%	18%	32%	32%
Uncertain About Future	23%	17%	23%	20%

As Table 6 illustrates, AI implementation remains limited across institutions. Only 22% of universities adopted AI systems; among these, private universities led with 38% compared to just 12% in public ones. Most implementations, at 68%, stayed at the pilot project stage instead of becoming institution-wide deployments. Meanwhile, 65% of private universities are committed to definite future AI plans, far surpassing the 35% of public institutions, which signals ongoing disparities in technological advancement trajectories.

Qualitative Analysis

Thematic Insights from Stakeholder Interviews

Thematic analysis of qualitative data collected from semi-structured interviews with 30 key stakeholders aimed to complement the quantitative results and yielded rich insights. Analysis of the qualitative data identified five themes.

Theme 1: Leadership Vision and Strategic Gaps

While some university leaders recognize AI's potential, they struggle to turn their vision into actionable, strategic plans. A vice-chancellor highlighted the importance of balancing operational needs with investments in new technologies. Most institutions lack comprehensive operational AI integration or adoption plans, forcing leaders to improvise. Many described a paradox where operational plans are aspirational but not aligned with practical strategic plans. This disconnection shows a gap between resources and the institution's operational realities.

Theme 2: Technical Infrastructure and Capacity Deficits

Technical challenges and infrastructure limitations were identified as the main reasons for institutions' hesitation to fully adopt AI. Concerns included bandwidth, outdated hardware, lack of systems for data capture, and insufficiently skilled technical staff. Respondents expressed frustration with decision-makers who did not fully appreciate the complexity and necessary resources for implementing AI. Many institutions still rely on legacy systems. As a result, required infrastructural changes present additional challenges before meaningful AI adoption. Technical staff must plan ahead to secure

ongoing resources for the long-term operationalization of AI. This includes external technical support, geomaps, and frequent system updates.

Theme 3: Faculty Attitudes and Resistance to Change

Faculty members' attitudes toward AI highlighted cross-generational differences. Concerns about AI training content led younger faculty to show enthusiasm, while older faculty focused on pedagogical value and viewed AI with skepticism. The adoption of technology raised worries about diminishing the human element in education and the potential for educator displacement. Respondents identified a lack of technology, inadequate training, and unclear processes as key sources of frustration, rather than aversion to technology itself. Faculty need meaningful involvement in AI decision-making and clear communication about how AI systems support educators.

Theme 4: Financial Sustainability and Resource Allocation

Every institution faces financial challenges, regardless of its type. Underfunded public universities must maintain even the most basic infrastructure. In contrast, private universities with stronger finances are concerned with justifying AI tool costs and assessing their value. Respondents worried more about the ongoing costs—such as software licensing, hardware upgrades, staff training, and maintenance than the initial investment. Stakeholders noted that pilot schemes often succeeded at first, but later phases collapsed due to a lack of ongoing funding and support.

Theme 5: Policy Frameworks and Governance Structures

A major theme raised by stakeholders was the absence of articulated, institution-wide policies for AI adoption. Department heads emphasized the urgent need for policies addressing data governance, AI ethics, accountability, and departmental evaluation. Stakeholders identified the Higher Education Commission's lack of national policy guidance as a reason other institutions display inconsistent policies. Many project participants reported that successful pilot initiatives stalled due to ambiguous governance and insufficient support systems. There is a pressing need for stakeholders to develop robust policies that balance innovation incentives with effective risk, ethical, and governance management.

Discussion

The Pakistani higher education scenario demonstrates complexities in AI adoption within the education industry. This is due to institutional diversity, various barriers, and the potential for limited opportunities. The study shows AI adoption is more advanced in private higher education institutions, primarily due to more sophisticated technology, better disposable income, and more flexible administration. In contrast, public institutions encounter more serious obstacles, such as tighter budgets and legacy systems that do not embrace modern technology. Even the more prosperous private regulators' AI initiatives face severe resistance from instructional constituencies, a lack of technical skills, and ambiguity surrounding the proposed AI. There is sustained apprehension about job security, concerns regarding the handling of private data, the obsolescence of legacy systems, and a likely lack of functional systems that support AI integration.

Alignment between quantitative and qualitative data strengthened the findings of the study. The patterns noted in stakeholder interviews matched the data. Financial constraints are the foremost challenge in Pakistani higher education, where basic operational and technological demands are poorly managed. Faculty reluctance to change shows that adopting AI requires both technical and cultural shifts. Most deployments are institution-wide, not pilot projects, which points to sustainability and scalability as major challenges for first implementations. This suggests Pakistani universities need context-appropriate adoption strategies that consider available resources.

Conclusion

The study reflected insights on patterns of AI adoption, the readiness of Pakistani higher education

institutions, and the challenges of implementation. Faculty and administrators showed interest in the AI potential. However, this did not translate into actual implementation. Even across different institutions, implementation was limited. Private universities demonstrated greater readiness and adoption than public and federally chartered institutions. This was mainly due to differences in infrastructure and financial resources. Even advanced institutions faced challenges. These included inadequate technical expertise, concerns about faculty commitment, and questions about ongoing resource provision. The findings clarify that advanced AI usage requires a simultaneous approach. Strategies must focus on technological frameworks, human capital, resources, and organizational culture.

The comparative framework showed institutional readiness involved more than technical factors. It included leadership, governance, strategic planning, change management protocols, and stakeholder inclusion. Concerns about the ethical aspects of AI adoption emerged, especially regarding job security for employees. This highlighted the need to address human and value-driven aspects. Training outcomes were limited. The professional training offered did not align with the necessary improvement and expansion of organizational capabilities. The research highlighted a need for strategic decision-making in integrating AI. This can help avoid increasing gaps within and between institutions as Pakistani universities develop.

As with the adoption of any other technology in a low-resource context, the study showed that technology frameworks developed in high-resource contexts need considerable adjustments to work in the developing world. The study provided much-needed evidence to guide educational technology policy, strategic planning at the institutional level, and resource allocation. By addressing barriers and factors related to institutional readiness, the study offered insights to help stakeholders promote effective AI integration. Most importantly, the study reaffirmed key needs for Pakistan's higher education sector: a realistic appraisal of readiness, a stepwise approach to adoption, investment in training and infrastructure, and consideration of policy and systemic issues alongside institutional initiatives.

Recommendations

Pakistani higher education institutions need to take phased, context-appropriate steps toward integrating AI, focusing first on strengthening infrastructure and building capacity before attempting higher-order steps. The Higher Education Commission needs to create national frameworks that provide guidelines for funding and AI adoption technical support, and build centers of excellence to develop AI expertise and share best practices. Resource centers should support these centers of excellence. Institutions must develop AI-focused faculty development programs that take an integrated approach to technical and pedagogical dimensions of teaching and learning. Cross-functional committees of faculty, administrators, IT staff, and students should be formed to provide transparent pathways for AI adoption and policy implementation. The frameworks for legal and ethical AI use, data privacy, and resource evaluation should be available before deployment on a large scale. Institutions can strategically integrate partnerships with technology companies and global organizations to enable smart resource use with implemented AI, providing service and infrastructure cost reductions for AI-integrated instruction and learning. Institutions need to conduct self-AI readiness and local context pilot AI use assessments/deployments before scaling, to ensure that AI use decisions are mission-critical and evidence-driven, and that the support of adopted AI actually mobilizes instructional capacity.

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