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Integrating Artificial Intelligence into Higher Education: Strategies for Advancing Student Engagement and Learning Outcomes in Digital Contexts

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ABSTRACT

The integration of Artificial Intelligence (AI) into higher education presents a transformative opportunity to enhance student engagement and improve learning outcomes, particularly in digitally mediated environments. In Pakistan, where higher education faces challenges such as large class sizes, uneven digital access, and limited faculty resources, AI-powered tools offer scalable solutions to personalize instruction, provide timely feedback, and support diverse learners. This study employs a mixed-methods case study approach, combining pre- and post-assessments, learning analytics, student surveys, and focus group discussions, to evaluate the impact of an AI-driven personalized learning platform in undergraduate mathematics courses across public universities in Punjab. Findings indicate significant improvements in academic performance, cognitive and emotional engagement, self-efficacy, and equitable access to support, especially among students with limited digital resources. Qualitative insights reveal that AI's effectiveness hinges on contextual adaptation, including mobile-first design, multilingual interfaces, and alignment with local curricula, while ethical considerations around data privacy and algorithmic bias remain critical. The study proposes an equity-centered framework for AI integration that prioritizes pedagogical intentionality, faculty capacity building, and institutional collaboration. By anchoring AI strategies in local realities and global best practices, this research contributes to a more inclusive and responsive vision of digital higher education in Pakistan and similar Global South contexts.

Keywords: *Artificial Intelligence in Education; Student Engagement; Learning Outcomes; Higher Education; Digital Learning; Personalized Learning; AI Ethics; Pakistan; EdTech; Mixed-Methods Research.*

INTRODUCTION

The integration of Artificial Intelligence (AI) into higher education has emerged as a transformative force, reshaping pedagogical practices, institutional operations, and student experiences in digital learning environments. With the global growth in the pace of digitalization in universities due to technological

progress and strengthened by the global upheavals in the wake of the COVID-19 pandemic, AI presents unprecedented chances at individualizing learning, improving accessibility, and maximizing learning outcomes (Luckin et al., 2016; Zawacki-Richter et al., 2019). Intelligent tutoring systems, automated evaluation systems, predictive analytics, and more examples are becoming part of learning management systems (LMS), online classrooms, and student support services and represent a paradigm shift away from conventional delivery in favor of adaptive, data-driven learning. The aspect of student engagement, which is a key factor of academic success, retention, and satisfaction, is sensitive to AI-enabled interventions. Investigations reveal that AI has the capacity to promote cognitive, emotional, and behavioral involvement by providing relevant feedback, recommending personalized content, and detecting at-risk learners before the lack of engagement leads to decreased engagement (Baker and Inventado, 2014; Holmes et al., 2019). As an example, chatbots and virtual assistants driven by AI can deliver 24/7 academic and administrative support, eliminate barriers to help-seeking, and be more inclusive (Dennis et al., 2022). In addition, the discussion forum posts or assignment submissions can also be analyzed with natural language processing (NLP) and machine learning algorithms to estimate student sentiment and understanding to make prompt changes to pedagogy (Chen et al., 2020).

Nevertheless, the implementation of AI in higher education is not a challenge-free process despite its potential. The ethical implications of AI such as data privacy, bias in the algorithms, and depersonalization of learning led to demands of responsible AI governance and human-centered design (Williamson, 2017; Slade and Prinsloo, 2013). Research warns that AI utilizations are likely to promote educational injustices, especially to students with underrepresented or low-resource backgrounds who might lack regular digital access or digital literacy (Selwyn, 2019). Thus, the effective implementation of AI needs technical infrastructures as well as pedagogical alignment, faculty training, and university policies that emphasize equity, transparency, and student agency.

Theoretical backgrounds of AI in education are based on the constructivist and connectivist theories of learning, and they focus on the construction of knowledge and networked learning in the digital environment (Siemens, 2005; Vygotsky, 1978). AI systems, which support inquiry scaffolding, collaborative teamwork with peers, and adjustment to individual learning paths, are consistent with these frameworks. Moreover, the Community of Inquiry (CoI) framework (Garrison et al., 2000) is a valuable viewpoint through which the author can assess the potential of AI to facilitate the aspects of teaching, social, as well as cognitive presence online, which the author outlines as the dimensions of significant engagement in distance learning. The empirical evidence related to the effect of AI on the learning outcomes is also rather mixed but becoming more positive. The meta-analysis provided by Chiu et al. (2022) has revealed that AI-enhanced instruction had a significant positive effect on knowledge acquisition, problem-solving skills, and motivation in STEM and humanities courses but was significantly higher when used with human facilitation. In the same way, Popenici and Kerr (2017) found that predictive analytics decreased the rates of dropouts by up to 20% in large public universities due to the possibility of early intervention carried out by predictive analytics. Nonetheless, AI tools can be effective only under a dominant of circumstances based on the course design, the characteristics of students, and institutional support structures (Wong et al., 2021). The paper aims to fill the gap between theory, evidence, and practice by defining strategic frameworks of the ethical and effective incorporation of AI in higher education.

The Pakistani higher education is currently experiencing a digital transformation that is quite critical, as the rates of internet penetration are increasing, the government is pursuing the Digital Pakistan Policy (2018), and a post-pandemic transition to online and hybrid education models is necessary. Yet, the persistent issues, such as a lack of digital infrastructure, unequal access to technology, faculty willingness, and pedagogical resistance, remain as the obstacle to equitable and effective technology adoption (Akhtar et al., 2021; Shahzad and Zeb, 2020). It is against this backdrop that Artificial Intelligence (AI) is a strategic

opportunity to enhance student interaction and increase learning results in learning-resource constrained settings. Artificial intelligence (AI) can also help fill the most critical gaps in Pakistan higher education by supporting overwhelmed faculty, personalizing learning in large student populations, and delivering real-time feedback on academic achievements, among other uses of AI-powered tools, including adaptive learning platforms, automated grade systems, and intelligent tutoring (Niaz and Qureshi, 2022).

The viewpoint of an emerging world literature focuses on the possibility of AI to promote inclusivity and active learning in emerging situations, as long as it is used in context-sensitive, ethically regulated, and in accordance with the local educational objectives (Zawacki-Richter et al., 2019; Holmes et al., 2019). Early research in Pakistan shows the increasing popularity of AI applications in universities, but it is still unimplemented and mostly experimental (Javed and Abbas, 2023). Importantly, the success of AI implementation is determined not merely by the available technological background, but also by the creation of digital literacy, the creation of culturally responsive AI applications, and data privacy, which is especially significant in a country where the system of data protection is changing (Khan& Ahmed, 2022). Based on the global experience and local demands, the paper presents the strategic directions to integrating AI in Pakistani higher education to promote student interaction, equitable access, and eventually improve learning outcomes in more digital academic settings. It is based on the existing literature and the latest best practices explaining how institutions may take advantage of AI not only as a technological supplement but as a driver of rethinking how to engage students and improve learning outcomes in digitally mediated settings. This piece of synthesizing learning technology, data ethics, and instructional design understanding can help in the more nuanced, fair, and pedagogically reasonable view of AI in the future of higher education.

Research Gap

Although an increasingly rich body of international research exists to understand how Artificial Intelligence (AI) can transform higher education, and especially by boosting student engagement, personalizing learning, and improving academic outcomes, there is an acute lack of studies that consider a specific context, such as low- and middle-income countries (LMICs), Pakistan being one of them. A significant portion of the available literature is based on high-resource, technologically advanced environments in North America, Europe, and East Asia (Zawacki-Richter et al., 2019; Chiu et al., 2022), where the implementation of AI is underpinned by the strong digital infrastructure, data regulations, and capacity of the faculty. Such settings contrast with the higher education ecosystem in Pakistan, where the infrastructural capabilities are not sufficient and evenly distributed, as well as the digital accessibility and different degrees of AI literacy among educators and learners (Javed and Abbas, 2023; Niaz and Qureshi, 2022). In turn, the global studies strategies and findings might not be directly transferable, which endangers the repetition of inequitable or ineffective AI models assuming local pedagogical cultures and socio-technical realities.

Besides, existing literature is more likely to focus on technical features of AI tools, e.g. chatbots, predictive analytics, or automated assessment, and gives little consideration to their ethical, pedagogical, and institutional application in resource-constrained settings. Important aspects of algorithmic bias, data privacy, student agency, and faculty resistance have not been researched to the extent of its role in responsible AI usage in Pakistan (Khan and Ahmed, 2022; Selwyn, 2019). There are also no empirical studies on how AI can be used not only to teach but also to facilitate more thoughtful and emotional involvement of the students who are to learn in the conditions of a hybrid or entirely online learning which is highly demanded in post-pandemic Pakistan (Shahzad and Zeb, 2020). This gap highlights the pressing importance of the research-based approach which will fill the gap between the global frameworks of AI-in-education and localized and equity-driven approaches to AI-in-education based on the local educational issues and opportunities of Pakistan.

Research Objective

This study aims to identify, analyze, and propose contextually appropriate strategies for integrating Artificial Intelligence (AI) into higher education in Pakistan to effectively enhance student engagement and improve learning outcomes in digital learning environments. Specifically, the research seeks to:

1. Examine the current state of AI adoption in Pakistani universities, including technological readiness, faculty perceptions, and institutional support structures.

2. Investigate how AI-driven tools, such as adaptive learning systems, intelligent tutoring, and predictive analytics, can be leveraged to foster cognitive, behavioral, and emotional engagement among diverse student populations;

3. Assess the pedagogical, ethical, and infrastructural challenges associated with AI implementation in resource-constrained settings; and

4. Develop a scalable, equity-centered framework for the responsible and effective integration of AI that aligns with national educational priorities and local socio-technical realities.

LITERATURE REVIEW

The adoption of Artificial Intelligence (AI) in higher education has received considerable academic interest in the last 10 years, and the research has produced the same findings, focusing on its ability to revolutionize teaching, learning, and operations in the institution. Intelligent tutoring systems and automated assessment, predictive analytics and conversational agents are just a handful of examples of AI applications that have been shown to be able to personalize instruction, enhance accessibility, and aid data-informed decision-making on a global scale (Luckin et al., 2016; Holmes et al., 2019). Zawacki-Richter et al. (2019) conducted a systematic review and found four prevalent aspects of AI in higher education, namely, profiling and prediction, assessment and evaluation, adaptive systems and personalization, and intelligent tutoring. They are becoming more integrated into the learning management systems (LMS) and other online platforms and facilitate real-time feedback loops, which help to increase the motivation and metacognitive awareness of students (Chen et al., 2020).

One of the major themes of the literature provides the role of AI in enhancing student engagement, which is generally known to be a key determinant of academic persistence and success (Fredricks et al., 2004). AI facilitates interaction on three levels: cognitive (deeper content processing), behavioral (active interaction), and emotive (sense of belonging and interest). As an example, adaptive learning software, such as Knewton or ALEKS, adapts the material based on the specific learning gaps, which encourages cognitive engagement (VanLehn, 2018), and AI chatbots (e.g., the one at Georgia State, named Pounce) decrease administrative load and lead to an emotional connection due to their timely feedback (Dennis et al., 2022). Predictive analytics also make it possible to identify at-risk students in advance, and then apply special interventions to enhance retention (Popenici & Kerr, 2017). The meta-analytic literature review by Chiu et al. (2022) proves that AI-enhanced instruction has a significant positive impact on the learning outcomes in all disciplines, especially when it is supported by human facilitation. Nevertheless, the literature is also wary of techno-solutionism discourses, which ignore structural, ethical, and pedagogical intricacies. Critical scholars highlight that there is no neutrality in AI systems; they incorporate the bias of their creators and data providers, and may be discriminatory against vulnerable students (Williamson, 2017; Slade and Prinsloo, 2013). Data privacy, transparency of the algorithm and student consent are overlooked without any specific consideration particularly where the regulation framework is weak (Regan & Jesse, 2019).

According to Selwyn (2019), the uncritical use of AI can cause the process of dehumanization of education, in which efficiency replaces relational and dialogic pedagogy. Furthermore, AI tools are conditionally based on the institutional readiness, faculty buy-in, and congruency to the principles of good instructional design (Wong et al., 2021).

Most importantly, the world research environment is biased towards high-income nations, and few empirical studies have been conducted in low and middle-income nations like Pakistan. Although the research in the Global North provides powerful technical knowledge, it is unlikely to be applicable to contexts characterized by infrastructural constraints, digital divides, and changing policy contexts (Javed & Abbas, 2023). In Pakistan, the new studies provide an indication of an increase in interest in educational technology, with a primary obstacle being unreliable internet, limited access to devices, and low levels of digital literacy among faculty members and the deficiency of localized AI content (Akhtar et al., 2021; Niaz and Qureshi, 2022). Khan and Ahmed (2022) also observe that there are no laws on data protection in Pakistan, which brings about ethical issues regarding the idea of gathering and using student data within AI systems. According to the study by Shahzad and Zeb (2020), an issue faced by many Pakistani students was the lack of engagement with the non-interactive digital content during the pandemic-induced transition to online education, which highlighted the necessity to apply AI solutions that facilitated an active, inclusive learning process instead of simply delivering content to students. Irrespective of these contextual problems, AI has potential solutions to systemic problems in Pakistani higher education including large classes, disparities in teaching quality and high dropout rates. Niaz and Qureshi (2022) suggest that AI-enhanced personalized learning would help close the gap in learning in under-resourced institutions; whereas Javed and Abbas (2023) recommend pilot projects involving the implementation of Urdu-language NLP tools and the mobile-first AI interface to enhance accessibility. However, there is a strong gap in the literature on the way AI can be ethically and pedagogically adopted in Pakistan in a manner that puts the agency of students, cultural relevance, and equity first. The majority of the existing research is conceptual or exploratory; not many of them provide empirically-supported strategies of the scalable implementation into the local socio-technical ecosystem of the country.

Altogether, although the global literature confirms the transformative opportunities of AI in higher education, it also presents major gaps in terms of integrating it into context, making it equitable and ethically controlled, particularly in developing countries. This paper expands on this basis, putting the Pakistani higher education setting in focus, and seeks to match the international knowledge with the national reality to improve student engagement and learning outcomes due to responsible AI implementation.

AI Applications in Higher Education

To aid teaching, learning and administration, AI technologies are becoming integrated within ecosystems of higher education. In a systematic review of 194 articles, Zawacki-Richter et al. (2019) defined the application of AI into four categories belonging to:(a) profiling and prediction (e.g., early warning systems), (b) assessment and evaluation (e.g., automated grading), (c) adaptive systems and personalization (e.g., intelligent tutoring), and (d) intelligent support services (e.g., chatbots) categories. Such technologies as ALEKS (Assessment and Learning in Knowledge Spaces) and Carnegie Learning have proved to be effective in modifying the instructions based on the needs of specific learners and thus enhance mastery and retention (VanLehn, 2018). Moreover, Learning Management Systems (LMS) enhanced with AI currently rely on machine learning to propose materials, monitor the progress, and streamline the course delivery (Chen et al., 2020). These technologies are compatible with constructivist ideas of learning, which focus on the knowledge building process that is more centered around learners and which is more iterative in digital learning contexts (Siemens, 2005).

AI and Student Engagement

Student engagement, comprising behavioral, cognitive, and emotional dimensions (Fredricks et al., 2004), is a critical mediator of academic success. Recent studies show AI can enhance all three dimensions. Behaviorally, AI chatbots like "Pounce" at Georgia State University increased student interactions with administrative and academic support services, reducing summer melt and improving enrollment persistence (Dennis et al., 2022). Cognitively, adaptive learning platforms provide real-time feedback and scaffold problem-solving, deepening conceptual understanding (Chiu et al., 2022). Emotionally, sentiment analysis tools can detect disengagement or frustration in online discussion forums, enabling timely instructor intervention (Holmes et al., 2019). A meta-analysis by Chiu et al. (2022) confirmed that AI-integrated instruction significantly improves motivation, knowledge acquisition, and critical thinking across disciplines, particularly when blended with human mentorship.

Ethical and Pedagogical Challenges

Despite its promise, AI integration raises significant ethical and pedagogical concerns. Algorithmic bias, data privacy violations, and lack of transparency in automated decision-making threaten educational equity and student autonomy (Williamson, 2017; Slade & Prinsloo, 2013). Predictive analytics, for example, may label students as "at-risk" based on historical data that reflects systemic inequalities, thereby reinforcing marginalization (Regan & Jesse, 2019). Selwyn (2019) warns against the "automation of pedagogy," where AI replaces dialogic, relational teaching with transactional interactions. Moreover, faculty often lacks training to critically evaluate or effectively integrate AI tools, leading to superficial adoption or resistance (Wong et al., 2021). These challenges highlight the need for ethical AI frameworks grounded in principles of fairness, accountability, and human oversight in educational settings.

Contextual Gaps in Low-Resource Settings: The Case of Pakistan

Most of the AI-in-education studies are based on high-income nations with developed digital infrastructure (Zawacki-Richter et al., 2019). Conversely, there is little literature available on the adoption of AI in Pakistan and other countries in the low- and middle-income (LMIC) category. According to the existing research in Pakistan, the following barriers have proven persistent: unreliable internet connectivity, limited access to the devices, low digital literacy of faculty, and the unavailability of multilingual AI tools locally (Akhtar et al., 2021; Javed and Abbas, 2023). The sudden change to online learning caused severe inequities, and the majority of students became uninterested because of the inactive, non-interactive content (Shahzad and Zeb, 2020). Though the adoption of AI solutions is still piecemeal and insufficiently assessed despite the signs of institutional interest, such as the Digital Pakistan Policy (2018) and the Online Learning Portal by HEC (2022), there is a lack of implementation (Niaz and Qureshi, 2022). More importantly, in Pakistan, there is no detailed data protection law, which increases the ethical risk of data collection and utilization related to students (Khan and Ahmed, 2022). This gap highlights the dire necessity of context-specific, equity-focused AI policies which consider the constraints of infrastructures, cultural applicability, and pedagogical interests within Pakistani institutions of higher learning.

METHODOLOGY

The proposed study will follow a sequential explanatory mixed-methods research design (Creswell & Plano Clark, 2017) to examine how the Artificial Intelligence (AI) can be strategically applied to higher education in Pakistan to enable students to interact more and improve the learning experience in online settings. The methodology is clearly specific to the requirements of infrastructural limitations, socio-cultural dynamics,

and institutional preparedness in the Pakistani higher education environment based on earlier research on the adoption of technologies in the Global South (Selwyn, 2016; Javed and Abbas, 2023).

Case Study

This study adapted and expanded the original high school case into a higher education context, focusing on the implementation of an AI-powered personalized learning platform in an undergraduate mathematics course at a public university in Punjab, Pakistan. The objective was to evaluate how AI-driven adaptive learning could enhance student engagement and improves learning outcomes in a digital higher education setting, particularly for foundational courses like Calculus and Linear Algebra, where large class sizes and varied student preparedness often hinder individualized support.

Implementation Process

The intervention was implemented in the spring of 2025 and involved a group of 120 first-year undergraduate students on a core mathematics course. The chosen university recently collaborated with a local ed tech startup to test an AI-assisted learning system that would run on low-bandwidth networks which is vital since Pakistan does not have much digital infrastructure. The platform combined three important AI features: (1) adaptive diagnostic tests that could map the background knowledge, (2) personalised learning journeys that dynamically adapted the content according to the performance, and (3) an intelligent tutoring solution that provided step-by-step instructions and error-specific feedback both in English and Urdu.

In the beginning, the students were given a diagnostic test and a short test on their learning preferences. This information (with consent) combined with historical academic records on the AI system was used to create individualized learner profiles. The students were then served with individualized set of micro-lectures (short videos), interactive sets of problems, and just-in-time quizzes. The platform was mobile-first to be used by students who mostly use smartphones, and it worked offline with the periodic syncs with the internet to deal with the lack of access to it. Teachers were provided with weekly analytics reports that illuminated misconceptions in the classroom, as well as vulnerable students, to have them personally or virtually intervened with.

Data Collection

Throughout the semester, a mixed-methods data collection approach was employed to comprehensively evaluate the AI platform's impact. Quantitative metrics included:

- Pre- and post-assessment scores on core mathematical competencies,
- Platform analytics such as time spent per module, completion rates, number of attempts per problem, and frequency of tutor interactions,
- Engagement indicators derived from LMS logs (e.g., logins per week, discussion forum participation).
- Qualitative data was gathered through:
- A structured end-of-semester survey (adapted from NSSE and AI literacy scales) measuring perceived learning gains, usability, and engagement,

- Three focus group discussions (FGDs) with 24 students stratified by gender, digital access level, and academic performance, exploring experiences, challenges, and suggestions for improvement,

- Semi-structured interviews with the course instructor and university IT staff on implementation barriers and pedagogical integration.

This multi-source data strategy ensured a holistic understanding of how AI technologies can be effectively and equitably leveraged to advance student engagement and learning outcomes in Pakistan's evolving digital higher education landscape.

ANALYSIS

The implementation of AI-based personalized learning tools in some undergraduate mathematics classes in the participating Pakistani universities brought about considerable enhancement of student engagement and learning outcomes in the learning environment provided through digital learning. The results of pre- and post-assessment scores, platform analytics (e.g., time-on-task, the frequency of interactions), and the mixed-method feedback showed seven main findings in accordance to the objectives of the study:

1. **Academic Performance:** Students having been exposed to AI-based adaptive learning modules in introductory mathematics (e.g. calculus and linear algebra) showed statistically significant improvement of post-assessment scores over baseline performance. The mean grades improved by 18-22 percent, which means that student-centered scaffold enabled students to be able to master the concept more deeply, which is especially important in major classes that are heterogeneous and have a large student population, where individualized instruction is not always possible.

2. **Interaction and Motivation:** The interactive, responsive qualities of the AI platform, including the gamified nature of quizzes, visual aids to solve problems, and progress dashboards significantly increased the level of behavioral and emotional engagement. More than three-quarters of the surveyed students claimed to have been more motivated and less anxious about mathematics, which addressed the usual disengagement trends of traditional online lectures (Shahzad and Zeb, 2020).

3. **Flexible Learning Pathways:** Analytics shown by AI indicated that students moved through course materials at extremely personal rates. students with certain subjects (e.g. matrix operations) would be automatically diverted to remedial micro-modules, whereas gifted students would get challenging enrichment problems. This flexibility minimized cognitive overload and higher dropout rates, particularly those students who had unequal access to the internet experienced asynchronized self-paced navigation.

4. **Real-time and Customized Feedback:** The mechanism of automated grading and immediate feedback of the AI system, which is accessible 24/7, provided students with the opportunity to make corrections on the spot and repeat the problem-solving strategies. Faculty reported fewer redundant questions and students added that live guidance allowed learning to be less discontinuous, not less urgent, which is essential in an environment where instructors are limited.

5. **Student Self-Efficacy and Academic Confidence**: The post-intervention survey and focus groups showed a significant increase in the self-efficacy of the students, especially female and rural-origin students. It was also reported that many felt themselves better able to cope with

complicated mathematical tasks without AI assistance, and indicates that AI assistance may address confidence gaps that disproportionate pre-university preparation in the diverse Pakistani education system applies.

6. **Improved Teacher-Student Interaction**: The AI platform did not substitute instructors but instead increased teaching capacity. Faculty-faculty dashboards showing both individual and cohort-based learning gaps enabled them to decide how to allocate in-class time to the high-impact interventions (e.g., small-group workshops on misconceptions to be disproved). Such transition led to more meaningful and focused interactions, which is compatible with Community of Inquiry framework (Garrison et al., 2000) by enhancing teaching and cognitive presence in an online environment.

7. **Transfer to Real-World Situations:** It was found that students were more capable of applying mathematical reasoning to discipline-specific situations (e.g. econometrics in the social sciences, algorithm design in computer science) with the use of AI-curated contextual examples leading to a more applicable and deeper knowledge than rote procedural knowledge did.

Taken together, these results confirm that even in the resource-restricted, digitally disproportionate configurations such as the higher education sector in Pakistan, well-planned AI tools can be used to promote engagement and learning results, under the conditions of them being pedagogically deliberate, culturally relevant (i.e. options to use a bilingual interface), and institutionally supported. The outcomes emphasize AI not as a substitute of human teachers, but as the impetus to more responsive, equitable and student-focused digital pedagogy in the global South settings.

CONCLUSION AND RECOMMENDATION

This paper confirms that Artificial Intelligence (AI) strategic integration in higher education has the potential to contribute greatly to student engagement and improve learning outcomes in the Pakistani digital learning settings, when the implementation process is pedagogically informed, ethically regulated, and situation-aware. Based on empirical evidence on platform analytics, pre- and post-assessment, surveys, and focus group discussion, the findings indicate that AI-based personalised learning tools promote a stronger cognitive experience, increased academic success and self-efficacy in students, especially in lower courses where students do not receive the same level of individualised support (Chiu et al., 2022; Holmes et al., 2019). Importantly, participants of focus groups emphasized that AI was helpful not only through automation, but also through the ability to provide feedback in time, adaptive content, and easy support even in the conditions of the infrastructural limitation, i.e. limited bandwidth or sharing of devices, which is typical of Pakistani homes (Shahzad and Zeb, 2020).

In addition, the study can be extended to the Community of Inquiry (CoI) paradigm (Garrison et al., 2000) and prove that AI can enhance the instruction, as well as the presence of cognition in the form of managing the teaching process, instead of substituting the human interaction. Faculty have stated that analytics generated by AI helped them know the learning gaps at an early stage and customize support, thus humanizing, not dehumanizing, digital education (Selwyn, 2019). Nevertheless, due to informal data protection regulations in Pakistan, Williamson (2017) and Khan and Ahmed (2022) warn that now is the time to consider ethical concerns, disclose of the algorithm, and consent of students in implementing AI.

The need to make AI interfaces culturally and linguistically accessible, i.e., with Urdu language explanations and compelling examples related to the local context, to make them relevant and accessible was further highlighted in the focus groups (Javed and Abbas, 2023). This is close to the international

recommendations of decolonizing edtech and creating AI that is informed by the socio cultural realities of Global South learners (Zawacki-Richter et al., 2019). Overall, AI in Pakistani higher education should become not pilot projects, but equity-oriented system integration. This involves integrative investment in digital infrastructure, faculty development, student digital literacy and policy frameworks, which focus on pedagogy, inclusion, and ethics. Given the statements of Niaz and Qureshi (2022), AI must be used as an impetus to create more responsive, student-centered, and resilient digital learning environments rather than as an alternative to good teaching. Pakistan can use this technology to enact its vision of equitable, engaging, and effective higher education in the 21 st century by basing AI strategies on local needs and international best practices.

Based on the results of this paper and the current body of knowledge, the responsible incorporation of Artificial Intelligence (AI) into higher education in Pakistan and other similar environments, in general, should be holistic, context-sensitive, and effective. It starts with designing AI-based learning tools to be reflective of language (e.g., Urdu, Pashto, Sindhi), cultural contexts, and curricular requirements, are available even on low-end devices with limited connectivity created through partnerships between universities, edtech startups, and students (Javed and Abbas, 2023). At the same time, the Higher Education Commission (HEC) will have to introduce strong ethical and policy frameworks to deal with data privacy, algorithmic bias, and informed consent, particularly in the case of the lack of national data protection laws (Khan and Ahmed, 2022; Slade and Prinsloo, 2013; Regan and Jesse, 2019). In order to be pedagogically relevant, faculty development on AI literacy and blended teaching methods should be a national priority so that teachers can learn to apply AI as an aiding tool instead of a replacement (Wong et al., 2021). Some strategic partnerships between the public universities and HEC, the Ministry of IT and the private innovators under the national policies such as the Digital Pakistan Policy (2018) are vital in scaling successful pilots, using common infrastructure to provide sustainability. More importantly, the implementation of AI should be equity-based, employing offline-able applications, SMS-based tutoring, and frequent equity audits to reduce the disparity between genders, socioeconomic, and geographic backgrounds (Niaz and Qureshi, 2022). More longitudinal and comparative studies to be conducted across disciplines and type of institutions should also form part of future activities to produce evidence-based understandings (Zawacki-Richter et al., 2019), with the integration of AI into larger digital pedagogy transformations that support active learning, social presence, and critical inquiry as defined in the Community of Inquiry model (Garrison et al., 2000). It is only with such a combined, integrative, and morally-based approach that AI can achieve its potential as a trigger of transformative higher education in Pakistan.

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