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Investigating the Impact of Ai-Driven Feedback Systems on Student Autonomy and Self-Directed Learning

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Abstract

This mixed-methods research examines the influence of AI-driven automated feedback systems on student autonomy and self-directed learning for the sample of 250 undergraduate students from the three biggest universities in Lahore, Karachi, and Islamabad, Pakistan. The researchers took a full academic semester and used a mixed-methods approach consisting of quantitative surveys and achievement tests and qualitative semi-structured interviews from students and faculty and used the pre and post intervention design which showed the clear improvement of students' self-directed learning readiness and autonomy levels corresponding to the use of artificial intelligence learning systems. The researchers performed quantitative analysis using SPSS which showed that there were changes on the scores and statistically significant differences on academic achievement and levels of learning independence of the students. On the qualitative side, the researchers performed thematic analysis in which the participants mostly pointed out improvement of personalized learning, enhancement of student motivation, interrupted technology adoption, over automation of feedback, need for human-AI balance. The participants' overall feedback showed that the AI automated feedback systems enabled enhancement of autonomous learning of students but cultural context, along with the degree of technological improvements available greatly influenced students' outcomes. The study concluded that the purposeful design of educational settings using AI automated feedback tools in higher education requires consideration of the educational context, the students' degree of digital literacy, the technological infrastructures of the educational institution and the pedagogical shifts expected, to optimize the use of artificial intelligence tools while engaging students in academic work.

Keywords: Influence, AI-driven, automated feedback systems, student autonomy, self-directed learning, Pakistan

Introduction

Recent developments in artificial intelligence have changed the way education is delivered around the globe, bringing forth new methods of teaching, learning, and assessing (Tariq, 2024). In Pakistan's higher education system, where classroom teaching is primarily dominated by lecture methods, the arrival of the AI-driven

feedback systems was both an opportunity and a challenge in relation to the first wave of educational reforms. These systems offered the potential for personalized learning experiences and immediate feedback to learners, along with the opportunity for continuous instructional guidance. These systems addressed some of the long-standing challenges of large classrooms and the inadequate individual attention learners receive in universities in Pakistan. The application of AI technologies in educational systems is an indicator of the shift from teacher-centered to student-centered approaches in the education systems, which may give students more control over their learning (Khan et al., 2025).

Student autonomy and self-directed learning were recognized as necessary skills within the 21st Century Education when people in the global workforce needed the ability to think independently, learn continuously, and solve problems adaptively. In Pakistan, educational systems underwent a significant cultural and pedagogical shift as the educational systems were typically centered around rote learning and teacher domination. Autonomy student learning had pedagogical conveniences as students received instant, personalized feedback on their work and identified their strengths and weaknesses without the teacher having to check in continually. The feedback made it possible for students to engage in educational self-regulation and develop their higher-order thinking constructively (Anwar et al., 2024).

Self-directed learning took root as educators recognized the need for a disengaged educator for learning to take place sustainably within the individual. Students from Pakistan were particularly challenged as they were used to highly structured learning environments where the primary focus was on exams. The systems were driven by adaptive feedback to improve student learning autonomy and self-directed learning. By offering students the ability to work at their own pace, these systems were able to close the gap between the traditional teaching methods and the academic self-regulation and independent inquiry required by contemporary learning (Anjum & Tapio, 2025).

The introduction of AI-driven feedback systems across Pakistan's HEIs raises important questions and concerns about the effectiveness of the systems and their impact on student learning behaviors and outcomes. Technology solutions claim to adjust to user needs and levels and enhance learning. However, the effectiveness of the systems is contingent on the following: the learning technology infrastructure of the institution, the digital literacy of the learners, the readiness of the instructors, and the culture of the institution regarding the use of technology for learning. The impact of the technological feedback systems on various student cohorts is greatly influenced by the Pakistan educational system's socio-economic diversity, the varying levels of technology access, and the disparity in educational quality across different regions. Therefore, understanding the systems is key for constructing a rationale to guide the investment and the strategic implementation of educational technology (Al-Barakat et al., 2025).

This study filled a significant void in education in Pakistan by exploring systematically how AI System Feedback impacted students' autonomy and self-learning in the confluence of Pakistan's cultural, technological, and educational milieu. Other studies have primarily concentrated on the West. As a result, a significant gap in the literature has emerged in the South Asian context whereby the effectiveness and the impact of such systems remain largely unaddressed. Specific attempts were made to provide evidence concerning the AI feedback systems and student autonomy the benefits, and issues, along with contextual variables in the South Asian milieu. While the Sprint sought to insightfully understand the experience of the participants to inform policies in education, this study collected and analyzed both qualitative and quantitative data to the Mexico educational policies, practices, and the use of technology in Pakistan, and other similar countries.

Research Objectives

1. To determine the extent to which AI feedback systems have positively impacted the levels of autonomy of undergraduate students in Pakistani universities.

2. To determine the extent to which AI feedback systems have impacted students' self-directed, learning, and academic performance.
3. To obtain and analyze the perceptions and experiences of students and faculty concerning the use and effectiveness of AI feedback systems in higher education.

Research Questions

1. What is the effect of ai-enabled feedback systems on the academic self-regulation of undergraduate students at the universities of Pakistan?
2. How do AI-enabled feedback systems impact the self-directed learning readiness and academic performance of students?
3. How do students and faculty perceive the use and impact of AI-enabled feedback systems on the promotion of self-regulated learning?

Significance of the Study

The present study is important for the various actors involved in the higher education system in Pakistan. The findings for the education policymakers constitute evidence-based potential of AI to tackle long-standing problems in student disengagement and learning quality, thus guiding potential policy decisions on the integration of educational technology in digital transformation projects. The university administrators and faculty obtained useful knowledge on the possible approaches, difficulties, and success factors for the integration of AI-enabled feedback systems in their institutions. The study added to the scarce educational technology literature in South Asia and offered useful contextual information to facilitate educational technology initiatives in other developing countries within the South Asia region. The students became the beneficiaries of the better learning opportunities offered by the institutions through the research findings on the effective use of AI feedback systems. Moreover, the mixed-methods design in the study provided a baseline which subsequent scholars could utilize to explore other educational technology applications and continue fostering the growing field of technology-enhanced learning in varying cultural settings.

Literature Review

In the previous decade, the utilization of the technology of artificial intelligence in pedagogy has been a developing scholarly domain as investigators have sought to understand the various applications of the technology of artificial intelligence in teaching and learning. In the beginning, scholarly work centered around the technological attributes of the artificial intelligence that included natural language processing, the technology of machine learning, and adaptive learning. However, the focus of scholarly work has been refocused on the outcomes of learning and the pedagogy of teaching and learning when educational technology that utilized artificial intelligence is integrated (Chen et al., 2022). Okagbue et al. (2023) examined the ways in which educational systems that utilized artificial intelligence are able to assist the pedagogy of personalized learning by acting in the capacity of a virtual teacher that analyzes the learning of a particular student, and provides feedback that is centered on the specific educational needs of that learner. It is this component that differentiates the systems that provided feedback in an artificial intelligence format and systems that provided feedback in an automated format. The feedback provided by automated systems on assessments was dichotomous, simply providing indicators that a response was correct or not, void of analysis on the learning of the student. In contrast, artificial intelligence systems engaged in formative assessment and provided feedback in a dynamic manner.

Educational theory has recognized 'student autonomy' as the ability of individuals to direct their own learning and make their own choices and end up taking responsibility for their educational outcomes. Educational psychologists, primarily influenced by the theories of constructivism, and self-determination theory, which focuses on the intrinsic motivation of the learner as well as their agency, posited the concept of learner

autonomy (Fatima & Ahmad, 2025). Findings from educational research showed that autonomous learners are high achievers, more able to persist on difficult tasks, and able to transfer their learning to new, appropriate, and applicable situations. However, in traditional educational systems particularly in South Asian countries, educational systems, particularly in South Asian countries including Pakistan, have student autonomy as a weakness because of the pedagogical approaches in which teacher control, standardized curriculum, and exam learning dominate. Scholars in the field pointed to the fact that student autonomy could only develop under specific educational processes that included the intentional design of the learning environment, supportive educational constructs, the ability of learners to self-regulate and make decisions (when as in control of the learning processes) (Yue et al., 2022).

The construct self-directed learning, although very similar, pertained more to the steps taken by individuals in anticipating learning gaps, establishing objectives, determining the appropriate resources, adopting specific plans, and assessing the results. Knowles pioneered self-directed learning and shaped the principles that continued to guide educational research and practice. It was found that the ability to self-direct one's learning was positively associated with success in both academic and professional advancement, and with the ability to learn throughout one's life. The learning self-direction ability was found to require scaffolding, especially in the case of students who were used to teacher-directed learning. Studies conducted in Pakistan showed the absence of inquiry-based pedagogies, very little opportunity to choose, and a cultural model that emphasized the submissive role of students were reasons students struggled with self-directed learning (BIBI et al., 2025).

The nexus between feedback and learning outcomes comprised a well-established domain of educational research where ample evidence suggested that effective and timely feedback was critical to enhancing learning (Akram et al., 2021). Higher education feedback practices were traditionally impacted by delays, and in some cases, were too narrowed and inconsistent because of large student cohorts and limitations in faculty workloads. AI feedback systems mitigated these issues by offering instantaneous feedback, analyzing student responses thoroughly, and maintaining consistent standards in evaluations. Studies showed that systems feedback that was automated address learning in a myriad of disciplines such as writing, mathematics, and programming. Still, some limitations were highlighted by scholars. These included the inability to provide complex nuanced feedback, contextual challenges surrounding the students, and the risk of simplification in learning (Nash, 2025).

Empirical studies examining the incorporation of AI feedback systems in the educational sector had disparate yet mostly encouraging findings in regard to the systems' impact on student learning outcomes. Experimental studies revealed statistically significant learning gains in the AI-assisted tutoring condition compared to the control condition receiving traditional instructional methods. Other studies observed the practice of AI feedback systems in lowering the students' assessment frustrations, improving the students' engagement, and increasing the amount of practice. However, other researchers chronicled the over-dependence of students on automated feedback, and the undue facilitation of the systems that led to a reduction in the critical thinking that the students exercised, along with the interruptions of in learning due to technical issues. These studies underscored the need for balanced technological support with sufficient unstructured opportunities for the students to engage in problem-solving, reflection, and self-regulation (Hooda et al., 2022).

Data on the challenges of AI integration into the Pakistani higher education system shows the system's unique opportunities as well. Numerous studies of the system's adoption of educational technology reveal gaps in the system's infrastructural support ranging from little to no internet access, poor access to hardware, and inadequate levels of assistance in educational technology. Digital literacy of Pakistani students shows the greatest disparity with urban students from the privileged class being more technologically adept than their peers from rural areas or the economically disadvantaged classes. Faculty education and training in the use of technologies in teaching remains inadequate and often view educational technologies as adjuncts to teaching, if not as optional (Ehtsham et al., 2023). Some of the stakeholders emphasize maintaining educational practices in the use of technology as culturally and pedagogically appropriate. The studies show an increasing

acknowledgment of the role of educational technology on the quality of education and the need to prepare students to compete in the international workforce from Pakistani educators and policymakers. These diffuse Pakistani educators show the need to conduct educational research in more culturally defined contexts and specifically in feedback instructional systems designed with Artificial Intelligence within the scope of the socioeconomic and educational systems to reflect how educational research multicultural systems to overcome the challenges of providing educational systems to lesser economically developed systems than the western educational systems (Ali, 2024).

Research Methodology

The researchers utilized mixed-methods approach to analyze the effects of artificial intelligence feedback systems on positive autonomy and self-directed learning. The sample comprised of 250 undergraduate students enrolled in three universities located in Lahore, Karachi, and Islamabad. Data collection took place after the first semester during which the students utilized AI learning platforms. The researchers obtained quantitative data by administering standardized surveys pre- and post- the intervention on student autonomy and self-directed learning readiness. The researchers obtained data on students' academic performance by administering achievement tests pre- and post the intervention, for a qualitative approach the researchers inter-viewed 30 students and 15 faculty members, purposefully selected to determine their experiences and perceptions of the AI feedback systems. Students' engagement profiles were analyzed to determine the effectiveness of the feedback by reviewing the interaction logs of AI platforms. The researchers utilized qualitative and quantitative data to conduct a thematic analysis in SPSS for quantitative data and NVivo for qualitative data. The researchers obtained ethical primary data by obtaining informed consent, and maintaining confidentiality during the research. The complex research design permitted the researchers to inform understand how the artificial intelligence feedback systems impacted the self-directed learning and autonomy in higher education students in Pakistan.

Results and Data Analysis

Quantitative Analysis

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

Variable	Category	Frequency	Percentage
Gender	Male	142	56.8%
	Female	108	43.2%
University Location	Lahore	89	35.6%
	Karachi	84	33.6%
	Islamabad	77	30.8%
Academic Year	Second Year	98	39.2%
	Third Year	152	60.8%
Prior Technology Experience	Low	67	26.8%
	Moderate	121	48.4%
	High	62	24.8%

The demographic distribution of participants demonstrated balanced representation across gender, university locations, and academic years. Male students constituted 56.8% while female students represented 43.2% of the sample. The three universities contributed nearly equal proportions of participants, ensuring geographic diversity across Pakistan's major urban centers. Third-year students formed the majority at 60.8%, providing perspectives from more academically mature participants. Regarding prior technology experience, most students reported moderate levels (48.4%), while low and high experience groups comprised 26.8% and 24.8% respectively. This distribution allowed for meaningful analysis of how technology familiarity mediated

the impact of AI-driven feedback systems on learning outcomes.

Table 2: Pre-and Post-Intervention Student Autonomy Scores

Autonomy Dimension	Pre-Test Mean (SD)	Post-Test Mean (SD)	t-value	p-value	Effect Size (Cohen's d)
Learning Independence	3.24 (0.78)	4.12 (0.64)	14.67	<0.001	1.24
Critical Thinking	3.18 (0.82)	3.89 (0.71)	11.23	<0.001	0.94
Decision Making	2.98 (0.88)	3.76 (0.75)	10.89	<0.001	0.96
Goal Setting	3.35 (0.74)	4.05 (0.68)	12.45	<0.001	0.99
Overall Autonomy	3.19 (0.69)	3.96 (0.61)	15.23	<0.001	1.18

The comparison of pre-and post-intervention student autonomy scores revealed statistically significant improvements across all measured dimensions. Learning independence showed the highest improvement with a large effect size (d=1.24), increasing from a mean of 3.24 to 4.12. Critical thinking, decision-making, and goal-setting abilities all demonstrated substantial gains with effect sizes approaching or exceeding 0.94, indicating meaningful practical significance. The overall autonomy score increased significantly from 3.19 to 3.96 ($t=15.23$, $p<0.001$), with a large effect size of 1.18. These results suggested that AI-driven feedback systems substantially enhanced students' capacity for autonomous learning across multiple dimensions, providing strong evidence for the intervention's effectiveness in promoting student independence.

Table 3: Self-Directed Learning Readiness Scale Scores

SDLR Component	Pre-Test Mean (SD)	Post-Test Mean (SD)	t-value	p-value	Effect Size (Cohen's d)
Self-Management	3.42 (0.71)	4.18 (0.59)	13.89	<0.001	1.16
Desire for Learning	3.67 (0.68)	4.25 (0.62)	10.67	<0.001	0.90
Self-Control	3.28 (0.79)	3.94 (0.67)	10.98	<0.001	0.91
Total SDLR Score	3.46 (0.64)	4.12 (0.57)	14.23	<0.001	1.10

Self-directed learning readiness scores demonstrated significant improvement following the intervention period. Self-management capabilities showed the greatest enhancement, increasing from 3.42 to 4.18 with a large effect size of 1.16, indicating that students substantially improved their ability to organize and regulate their learning activities. Desire for learning increased from 3.67 to 4.25, suggesting enhanced intrinsic motivation and enthusiasm for educational engagement. Self-control abilities improved from 3.28 to 3.94, reflecting better impulse regulation and persistence in learning tasks. The total SDLR score exhibited a significant increase from 3.46 to 4.12 with a large effect size of 1.10, providing robust evidence that AI-driven feedback systems positively influenced students' readiness for self-directed learning across all measured components.

Table 4: Academic Performance Outcomes

Assessment Type	Pre-Test Mean (SD)	Post-Test Mean (SD)	t-value	p-value	Effect Size (Cohen's d)
Formative Assessments	62.34 (12.45)	74.28 (10.67)	12.34	<0.001	1.03
Summative Examinations	58.67 (14.23)	69.45 (12.89)	9.78	<0.001	0.80
Assignment Quality	64.12 (11.78)	76.89 (9.34)	14.56	<0.001	1.20
Overall Academic Performance	61.71 (11.89)	73.54 (10.23)	13.45	<0.001	1.06

Academic performance metrics demonstrated substantial improvements across all assessment categories following the AI feedback system intervention. Formative assessment scores increased from 62.34 to 74.28, representing a 19.2% improvement with a large effect size of 1.03. Summative examination performance improved from 58.67 to 69.45, indicating that benefits extended beyond immediate feedback contexts to formal testing situations. Assignment quality showed the most dramatic improvement, increasing from 64.12 to 76.89 with the largest effect size of 1.20, suggesting that iterative AI feedback particularly enhanced students' work quality. Overall academic performance increased significantly from 61.71 to 73.54, demonstrating that AI-driven feedback systems produced meaningful improvements in student achievement across diverse evaluation methods.

Table 5: Correlation Analysis Between Variables

Variable Pair	Pearson r	p-value	Interpretation
Autonomy & SDLR	0.78	<0.001	Strong positive correlation
Autonomy & Academic Performance	0.64	<0.001	Moderate positive correlation
SDLR & Academic Performance	0.71	<0.001	Strong positive correlation
Technology Experience & Learning Gains	0.42	<0.001	Moderate positive correlation
AI Platform Engagement & Autonomy	0.69	<0.001	Moderate positive correlation

Correlation analysis revealed significant positive relationships among key study variables. Student autonomy and self-directed learning readiness demonstrated a strong positive correlation (r=0.78), confirming theoretical assumptions about their interconnected nature. Both autonomy and SDLR showed significant positive correlations with academic performance (r=0.64 and r=0.71 respectively), indicating that these learner characteristics translated into tangible achievement gains. Prior technology experience exhibited a moderate positive correlation with learning gains (r=0.42), suggesting that digital literacy facilitated but did not determine intervention success. AI platform engagement correlated moderately with autonomy development (r=0.69), highlighting the importance of active system utilization in realizing benefits. These correlations provided valuable insights into mechanisms through which AI feedback systems influenced educational outcomes.

Table 6: Comparison of Outcomes by Technology Experience Level

Experience Level	N	Autonomy Gain	SDLR Gain	Performance Gain	Platform Engagement
Low	67	0.68 (0.34)	0.54 (0.38)	9.23 (4.67)	3.45 (0.89)
Moderate	121	0.79 (0.31)	0.68 (0.35)	12.45 (4.23)	4.12 (0.76)
High	62	0.85 (0.28)	0.73 (0.32)	13.67 (3.89)	4.56 (0.68)
F-statistic	-	6.78**	7.23**	11.34***	18.45***

Analysis of outcomes by prior technology experience levels revealed differential gains across groups. Students with high technology experience achieved the greatest improvements in autonomy (0.85), SDLR (0.73), and academic performance (13.67 points), while also demonstrating highest platform engagement (4.56). Moderate experience students showed intermediate gains, and low experience students exhibited smaller but still meaningful improvements. ANOVA results indicated statistically significant differences among groups for all outcome measures ($p<0.01$ for autonomy and SDLR; $p<0.001$ for performance and engagement). However, the fact that low experience students still demonstrated substantial gains suggested that AI feedback systems remained beneficial across technology proficiency levels, though digital literacy enhancement could optimize outcomes. These findings highlighted the importance of considering student backgrounds when implementing educational technology interventions.

Qualitative Analysis

Theme 1: Enhanced Personalized Learning Experience

Students reported AI feedback mechanisms are highly personalized and adaptable to individual learning needs and preferences. Respondents appreciated tailored feedback adjustment based on prior performances and mistakes rather than a one-size-fits-all approach. For example, one student explained how the system identified specific problem areas and served up additional practice meant to remedy those issues. Faculty noted a pattern where students were more deeply engaged when feedback was individually tailored versus when feedback was provided in a more generalized fashion. Other respondents expressed how the personalization at times came across as cold and robotic, lacking the warmth and understanding of a teacher. Feedback in such personalized ways was the single most distinguishing factor of AI vs. traditional mechanisms in assessment.

Theme 2: Immediate Feedback and Learning Acceleration

A major characteristic of the participant experience was the ability to receive immediate feedback in near real-time. With the ability to receive immediate feedback, participants indicated that they were able to understand the error and instantly be able to correct the error in their responses and continue to learn without a multi-day gap without feedback from the instructor. Participants indicated that feedback in real-time without waiting a long time enabled their learning to be continue without stops and they were able to work through multiple iterations of their responses without being stopped in their learning path in an anxiety automated manner. Instructors and educators also indicated that with the immediate feedback with errors, they were able to bypass the numerous corrections of errors in a response by being able to focus in their instructional time on higher level concerns. Several participants also indicated that real-time feedback kept them from losing interest and disengaging from their learning. The feedback allowed their learning to be more efficient.

Theme 3: Development of Self-Regulatory Skills

Interaction with AI feedback systems resulted in the development of self-regulation and metacognition skills as described by the participants. Students described the process of learning how to independently analyze feedback, recognize repeating patterns within their mistakes, and devise customized improvement methodologies. Students receiving feedback proactively, as opposed to waiting for a teacher's evaluation, was a result of the system's constant availability. Observing learning processes to become self-reflective, students strategically completed assignments. Time management and goal setting improvement was a result of system use, as described by the participants. AI feedback systems functioned as a means of academic scaffolding. This was the primary insight in self-regulation and self-directed cognitive behavior development; the goal was improvement, though immediate performance outcomes were behavioral.

Theme 4: Technology Adaptation Challenges

Despite the general positive impressions of the use of implemented technologies, the participants met with specific challenges in the use of approaches. As the students encountered difficulties in the navigation of the platform, the comprehension of the required systems and the resolution of technical problems, the students located in the lower socioeconomic and infrastructurally weak areas were more affected by the problems of internet connectivity. Frustration was raised by some participants when systems failed to respond to the context of the specific aspects of their work. Faculty participants acknowledged the considerable time and resource investments that the institutions had to allocate to facilitate the adoption of technology. Students with lower technology experience required more assistance, and were encountered with more difficult challenges that resulted in bigger learning curves. These challenges dissociated the implementation of the approaches from the infrastructure, technical support, digital literacy, and the implementation of AI systems.

Theme 5: Concerns About Over-Reliance and Reduced Critical Thinking

Some concerns were raised with respect to the apparent tendency to over rely on AI feedback and the potential for an adverse effect on the development of critical thinking skills. A number of students admitted to feeling overly reliant on the system's guidance and being anxious/nervous when working with the system turned off and no automated feedback was available. There were worries among faculty that students might become excessively reliant on the AI responses and may eventually lose the ability to solve problems and think creatively on their own. There was a noticeable tendency for some students to simply apply feedback suggestions without a proper understanding of the fundamental principles. The systems being discussed provided students with instantaneous responses to problems and a number of students expressed their worry that this would deny them the chance to learn from their own mistakes and reflections. The feedback provided by the students in response to the survey demonstrated an understanding of the need for systems to be implemented in a way that utilizes the AI in a manner that does not inhibit the unassisted thought processes and intellectual exertion that is so crucial for learning to occur.

Theme 6: Desire for Balanced Human-AI Interaction

Almost all participants commented on the necessity of retaining the role of human instructors along with AI feedback systems. Students appreciated some level of feedback from the teachers, since deeper and more nuanced emotional and contextual understanding cannot be processed by AI. Likewise, faculty members acknowledged the importance of human interaction while teaching as emotional and personal circumstances of students need to be taken into consideration, which cannot be understood by an algorithm. There is a need to balance AI feedback systems with teaching human students. Students need feedback from a teacher, and they need to know a teacher is available to answer questions even if feedback from an automated system is present. This theme demonstrated that AI feedback systems do not replace human instructors, but rather serve to complement human instruction.

Discussion

The findings demonstrated the impact of AI-backed feedback mechanisms in fostering the students' autonomy and self-directed learning behaviors of Pakistani undergraduate students and the key contextual factors influencing the outcomes. This positive change in autonomy, self-directed learning readiness, and self-directed learning academic achievement provided evidence for the capacity of AI-assisted technologies to respond to the paradox of the Pakistani higher education system. Autonomy and academic achievement demonstrated the educational value of the autonomy advocated was learner independence. The uneven positive change in autonomy was self-directed learning academic achievement was related to the level of experience of the technology and emphasized the key importance of the digital literacy of the participants to align the technology to their academic needs. The qualitative findings illustrated the students' complexity arising from their enthusiasm to over-rely on technology, their needs for personalized learning, instant feedback, the feedback being technologized, and the need for over-reliance on human intervention and instruction. This technological paradox reflects the secondary education systems of developing countries and their level of educational infrastructure and technological readiness. The need for educational systems to retain human interaction further emphasizes the importance of human agency in the educational system and not in the total replacement of educational systems. The findings matched with international research exemplifying the AI feedback systems potential while also extending understanding to the South Asian region with unique educational cultural, technological, and institutional systems. The use of the mixed methods approach allowed the research to capture complexity that may arise from pure quantitative studies especially regarding the implementation challenges and the students’ concerns that may threaten the sustainability of the initiatives in the long run.

Conclusion

The evidence indicating the influence of AI-enabled feedback systems on the development of students' self-directed learning and autonomy in the context of higher education in Pakistan is overwhelming and positive. The AI-enabled feedback systems have also demonstrated impact on the development of self-directed learning and academic performance. While the evidence illustrates the ability of the AI systems to respond to challenges in educational quality issues in low-resource settings to some extent, it shows that the challenges of low-resource settings are more complex. On the positive side, the evidence illustrates, in a way, the type of challenges that exist for educational institutions that are also low-resource: the support that institutions provide is training for the faculty and students on the use of digital technologies. The research findings AI-enabled feedback systems illustrate the support of and enhancement of feedback systems. The outcomes demonstrate the need for educational systems to implement feedback in a way that incorporates a continuum of educational systems. Within the context of the educational systems of Pakistan, traditional educational systems, the educational systems of Pakistan are researched. The research provides contextual evidence for educational systems in South Asian countries that have low educational technology. The educational systems in developing countries should provide systems that have adequate and equitable access to educational technologies, and that educational systems are designed to preserve the pedagogical systems that are essential to teaching. The pedagogical systems should use educational technologies that provide feedback to learners to develop their ability to learn independently.

Recommendations

Given the results of the research, the researchers suggested that Pakistani universities initiate the establishment of holistic digital literacy training courses aimed at equipping students for interaction with AI-based learning technologies. Educational institutions must ensure the provision of high-quality technological resources like high-speed internet and sufficient computing devices for an equitable digital divide solution. Faculty training programs must help teachers learn how to use MI feedback pedagogically without losing the human touch and the higher order teaching functions. The higher education sector should adopt hybrid models of implementation that limit the use of automated feedback to simple tasks while reserving more complex tasks that require higher order human evaluation for thorough human mentoring. There must be AI education policies that support ethical use of AI while considering the diverse elements of data privacy and security, algorithmic opacity, and justice. Educational institutions must establish Tier 1 tech support systems for students and faculty in order to overcome the barriers to adaptive use of technology. The impact of AI feedback systems should be the primary focus of future research in order to understand the impact of such systems on graduate outcomes as well as to unmask the best use of such systems in various areas of study.

References

Akram, M., Ahmad, S., Ishaq, G., & Javed, M. (2021). The impact of ESL teachers' use of demotivational language on students' learning: A study of ESL learners at secondary level in Pakistan. *Communication and Linguistics Studies*, *7*(3), 44.

Al-Barakat, A., AlAli, R., Alotaibi, S., Alrashood, J., Abdullatif, A., & Zaher, A. (2025). Science education as a pathway to sustainable awareness: Teachers' perceptions on fostering understanding of humans and the environment: A qualitative study. *Sustainability*, *17*(15), 7136.

Ali, M. M. (2024). *Technology-based teaching and learning in Pakistani English language classrooms*. CRC Press.

Anjum, R., & Tapio, P. (2025). TRANSFORMING PEDAGOGY: SHIFTING PERSPECTIVE FROM TEACHER-CENTRED TO STUDENT-CENTRED AT SECONDARY LEVEL EDUCATION IN PAKISTAN.

Anwar, R. H., Yahya, U., & Zaki, S. (2024). Values Ingrained in Pakistan's Education System. In *Worldviews and Values in Higher Education: Teaching, Learning, Curricula, and Assessment* (pp. 211-224). Emerald Publishing Limited.

BIBI, D. W., AKBAR, D. H., AHMAD, S., & MUSHTAQ, S. (2025). EXPLORING PRIMARY SCHOOL TEACHERS'PERSPECTIVES ON THE IMPLEMENTATION OF THE SINGLE NATIONAL CURRICULUM IN DISTRICT PESHAWAR. *TPM–Testing, Psychometrics, Methodology in Applied Psychology*, *32*(S7 (2025): Posted 10 October), 185-193.

Chen, X., Zou, D., Xie, H., Cheng, G., & Liu, C. (2022). Two decades of artificial intelligence in education. *Educational Technology & Society*, *25*(1), 28-47.

Ehtsham, M., Ahmad, S., Anjum, H. M. S., Shaker, A. S. A., Sajid, M. K. M., Lodhi, K., & Al Anazi, N. (2023). A Study Of Teachers' And Learners' Approach Regarding Code-Mixing And Code-Switching In English Language Classrooms At College Level. *Journal of Namibian Studies*, *33*.

Fatima, N., & Ahmad, S. (2025). Formulaic language in high-stake research writing: Investigating the semantic implications of collocations and fixed expressions in postgraduate dissertation. *Research Journal in Translation, Literature, Linguistics, and Education*, *1*(4), 36-47.

Hooda, M., Rana, C., Dahiya, O., Rizwan, A., & Hossain, M. S. (2022). Artificial intelligence for assessment and feedback to enhance student success in higher education. *Mathematical Problems in Engineering*, *2022*(1), 5215722.

Khan, I. A., Khan, K. A., & Mahmood, N. (2025). The Future of English Language Teaching in Pakistan: A Comparative Analysis of AI-Driven and Human-Led Instruction. *Liberal Journal of Language & Literature Review*, *3*(1), 315-330.

Nash, R. A. (2025). Universities' policies on feedback speed do not meaningfully predict students' satisfaction with assessment and feedback. *Assessment & Evaluation in Higher Education*, 1-12.

Okagbue, E. F., Ezeachikulo, U. P., Akintunde, T. Y., Tsakuwa, M. B., Ilokanulo, S. N., Obiasoanya, K. M., Ilodibe, C. E., & Ouattara, C. A. T. (2023). A comprehensive overview of artificial intelligence and machine learning in education pedagogy: 21 Years (2000–2021) of research indexed in the scopus database. *Social Sciences & Humanities Open*, *8*(1), 100655.

Tariq, M. U. (2024). *AI-Driven Learning and Engagement in Higher Education*. IGI Global.

Yue, M., Jong, M. S.-Y., & Dai, Y. (2022). Pedagogical design of K-12 artificial intelligence education: A systematic review. *Sustainability*, *14*(23), 15620.