



AI-Driven Personalized Learning and Learning Analytics in Higher Education: Effects on Student Engagement, Achievement and Research Integrity

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ABSTRACT

The study aimed to examine the effect of personalized learning through artificial intelligence (AI) and learning analytics on student engagement and learning outcomes of higher education institutes in Pakistan with implications for Research Integrity at these institutes. Adopting a mixed methods approach, quantitative data gathered from 500 students from an undergraduate science program, with semi structured interviews with 30 students for the qualitative data. The descriptive statistics indicated that the mean engagement scores for those students who have access to AI based personalized learnings were significantly higher than the mean scores of students in traditional learning setting; it is from these that an increase in engagement by the students were observed. There was an improvement in Academic achievement as well, as indicated by higher grade point averages, and improved scores of the formative assessments. The regression analysis results showed that AI (personalized learning) and learning analytics ($\beta = .41$; $p < .001$) were among its most important models that were significant in predicting the variable of academic achievement; the analysis of correlation results showed that there was a good positive correlation between the variables of engagement and academic achievement ($r = .63$, $p < .01$). The qualitative results corroborated this as students felt there was a significant increase in motivation, personalized feedback, and adaptive learning pathways as being the most beneficial aspects of the AI integration. Issues were identified that could interfere in successful implementation: Data privacy concerns, uneven access to technology and insufficient faculty preparation. According to this study, personalized learning & learning analytics with AI have proved to be significant drivers of student engagement & academic performance, provided that the ethical issues and infrastructure are sorted out and this may influence the way research integrity and rigor will be upheld within Higher Education Institutions. The findings herein expand the conversation taking place around the role of AI in education and highlight the need to embed learning analytics in a learning design practice, to create inclusive and effective learning spaces.

Introduction

In the field of higher education, artificial intelligence (AI) and learning analytics have emerged as transformative forces that shape the landscape of education, both in its perception and its dissemination. Artificial Intelligence (AI) and learning analytics are potent gamechangers in the realm of higher education, influencing the education landscape in both its perception and dissemination. From a teaching and learning point of view, the phenomenon of Artificial Intelligence (AI) and learning analytics cannot be ignored as it is impacting the paradigm of learning and education itself (Makhdum, et al., 2023). The use of AI algorithms and analyses can

support personalized learning, adapting educational experiences to a student's needs, preferences and learning patterns. In the global context, institutions are more and more integrating AI powered platforms in order to strengthen the relationship with the students in the pursuit of higher student performance (Zawacki Richter et al, 2019). Learning analytics, which is the measurement, collection and analysis of student information to enhance learning environments, is a vital tool in identifying at risk students, timely giving of feedback and adaptation of learning paths (Siemens, 2013). Higher education institutes in Pakistan are just starting to take these innovations into account, but there is very little systematic integration.

In environments dominated by traditional teaching and assessment methods, where having access to a diverse learning environment can be a challenge due to class sizes and standardized teaching-learning plans, the use of AI and learning analytics in personalized learning takes on great importance. The potential of personalized learning with AI can be used to tackle these challenges through the delivery of personalized feedback, adaptive content delivery, and predictive analytics of student performance. This research studies and investigates personalized learning and learning with AI in higher educational system of Pakistan on students' engagement and achievement.

Significance

This Study has significance in many respects. One it puts Pakistan in the spotlight of the global discourse on "Education and AI" and includes Pakistan in the current speech of Personalized Learning and Analytics in education. Firstly, it places Pakistan in a global landscape conversation focused on the global conversation of 'AI' in Education contributing the Pakistani perspective to the ongoing debate on personalized learning and analytics. Second, it provides empirical evidence of the effects of the implementation of AI platforms to implement personalized learning on student engagement and achievement the gap in the literature around these tools is so intense that it focuses only on how to use them and what to expect, leaving out any empirical evidence (Younas, et al., 2023). Last but not least, it is leveraged for informing policies and practices, while highlighting the role of technology, and in this case AI and analytics, in supporting the effectiveness of learning and teaching. Finally, it helps to create inclusive and equitable learning spaces, by pointing out issues of access and protection of information, of access and protection of learning and of teacher preparation (Khan & Younas, 2021). Last but not least, the study is related to Sustainable Development Goal (SDG 4) (Faisal, et al. 2024) "Providing inclusive and equitable quality education inclusive by fostering student centred learning". AI explored in this study is one of the potential means to achieve student centred learning (Khan, et al., 2024).

Problem Statement

While the world is progressing towards AI-powered personalized learning and learning analytics, the application of these innovations at the higher education level in Pakistan is marred by some big challenges. They are taught in a traditional way and there is not a lot of individualisation in learning. Large classes can make it hard to engage students, standardized curricula and limited mechanisms for feedback can further constrain student engagement. No adaptive learning pathways and prediction analytics to identify at-risk students can impact academic progress. AI and learning analytics can be effective tools in addressing these challenges; however, its adoption in Pakistan's higher education system is yet to be wide-spread, and there is not much empirical evidence to show how AI and learning analytics impact higher education. This study seeks to explore these gaps to illuminate how AI and learning analytics contribute to personalized learning effects on student engagement and achievement.

Objectives

1. To discuss the impact of AI supported Personalised Learning in Higher education on student engagement.
2. To evaluate the effects of Learning Analytic for undergraduate students' achievement.
3. To explore the correlation between personalized learning, students' engagement and academic performance in the context of AI-assisted learning.

Research Questions

- What are the effects of AI-enabled personalized learning on student engagement in higher education?
- How does the use of learning analytics influence academic achievement among undergraduate students?
- What is the relationship between personalized learning, student engagement, and academic achievement in AI-driven learning environments?

Gaps

Previous studies have comprehensively investigated the notions of digital literacy and the integration of digital technologies in learning, while offering limited empirical evaluations of personalized learning and learning analytics amplifying use of AI in Pakistan. The literature extensively explores digital literacy and the integration of digital technologies in learning, with a sparse and fragmented empirical investigation of AI-facilitated personalized learning and learning analytics in Pakistan. While the majority of research examines the adoption of various technologies in general, the impact of AI and analytics on engagement and achievement is not always addressed (Iqbal & Bhatti, 2022.). In addition, comparative research on personalized learning outcomes is still limited, and there is a lack of information on how Personalized Learning can impact student experiences at the local level and through the use of AI and analytics. This study will fill these voids by providing empirical evidence about the impact of Personalized Learning via AI and LA on student engagement and academic performance in Higher education in Pakistan (Younas, et al., 2022)

Literature Review

Personalized learning is the process of customizing instruction for the student to address student needs, preferences and performance. Data analysis, pattern recognition, and content delivery are key functions where AI shines, helping to enable individualised learning experiences. AI has a major part to play in enabling personalisation by analysing large data sets to identify patterns in learning, as well as delivering adaptive content as well. The growth of AI technologies indicates a need for educators to understand the emerging role of AI to effectively create personalized learning environments (PLE), stating this by Long and Magerko 2020 (Abbas & Faisal, et al., 2024.). Research shows AI-powered personalization increases motivation, engagement and learning outcomes (Chen et al., 2020).

Learning Analytics is the deal with collecting and counting information about students to help increase studying environments (Begum, Yaseen & Faisal, 2025). The term learning analytics was coined by Siemens (2013) as a way to understand and improve learning processes using data. The research findings suggest that learning analytics could be used to detect at-risk students, give immediate feedback and help guide students on their adaptive learning trajectory (Yao & Ifenthaler, 2020). There is limited empirical research in Pakistan on the contribution of learning analytics on academic outcomes, therefore it is imperative to investigate the potential of learning analytics.

Students presence is an essential factor in order to achieve good results. From an engaging perspective, Fredricks et al. (2004) conceptualized engagement as being behavioural, emotional, and cognitive in nature, that is, as an involvement in learning activities (Faisal, et al., 2023). Applying AI technologies in personalized learning and analytics has been found to improve engagement with the provision of customized feedback, interactive content and adaptive pathways (Zawacki Richter et al., 2019). The discussions underscore the importance of traditional teaching approaches, particularly in South Asia, where engagement can often be limited, reflecting the transformative power of AI in shaping learning experiences. (Younas, et al., 2022)

There are a number of influences on academic achievement, these include engagement, feedback and learning pathways. Studies have shown that AI-powered personalized learning positively influences achievement by tailoring content to the needs of students and offering predictive information on student performance (Tuomi, 2018). Learning analytics also plays an important role in achieving learning goals by helping to pinpoint students' needs and provide interventions (Ifenthaler & Yau, 2020).

Challenges in AI Integration

Although the potential looks good, the implementation of AI and LA in education has many obstacles to overcome (Faisal, et al., 2023). Ethical aspects (fairness, accountability and transparency) have been mentioned by Floridi et al. (2018). Global data beyond privacy concerns has been raised by Jobin et al. (2019) about possible biases in algorithms. There is a lack of compatible infrastructure, availability of technical skills, and faculty development that further contributes to deficit in implementation in Pakistan (Iqbal & Bhatti, 2022).

Gaps in Existing Literature

While global research has demonstrated the benefits of AI-enabled personalized learning and learning analytics, empirical studies in Pakistan remain limited. Most local research focuses on general ICT adoption, overlooking the specific effects of AI and analytics on engagement and achievement. Comparative analyses of personalized learning outcomes are scarce, leaving gaps in understanding cohort differences and contextual challenges. This study addresses these gaps by providing empirical evidence on the effects of AI-enabled personalized learning and learning analytics in Pakistan's higher education system.

Methodology

The mixed methods research design was used for the overall effect of the use of Artificial Intelligence (AI) and learning analytics on student engagement and academic outcomes of the HEIs in the context of Pakistan. The special focus was put on the quantitative strand to gather quantitative statistical data, and the qualitative strand had been used to get insights into students' experiences and perception. These methods allowed for a breadth and depth of generating the solution to research aims.

The prime research tool was the designed questionnaire which was developed based on the literature studied on the topics of AI Derived Personalized Learning, Learning Analytics, Student Engagement and Academic Achievement. The questionnaire consisted of two-parts: the first part included demographic information while the second part included the standardized items that were rated in 5 points Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Data about age, gender, discipline, type of institutionalization and year of study were gathered by the demographic section. The items on the Likert scale measured aspects related to learning dimensions like adaptive learning, individualized feedback, and predictive learning; learning analytics, student data-driven feedback, identification of at risk students, and optimization of learning environments; the elements of student engagement, including behavioural, emotional and cognitive involvement and academic achievement (grades, performance in formative assessments and self reported learning outcomes). The instrument passed the process of educational technology and pedagogical experts to achieve content validity and to match the objective of the investigation.

The data collection was carried out from different public and private universities of Punjab, Sindh and KPK to cover variation of institutional settings. There was formal permission obtained from the university authorities and clear information about the purpose of the study, confidentiality measures and voluntary participation. A questionnaire was launched via electronic means via both institutional learning management systems and email as well as in print where feasible to maximize geographically access. The survey was completed in a total of two weeks with reminders being sent out in order to increase response rates. Questionnaires that were completed were checked to be complete and subsequently coded for statistical analysis. Responses were discarded due to quality and reliability of the data if there were significant gaps.

Purposive sampling was selected because it allowed the researcher to target individuals most capable of providing relevant information on AI-enabled personalized learning and learning analytics. This technique was particularly suitable given the study's focus on students who represent a distinct cohort within the higher education system. By selecting participants with direct experience of AI-driven learning environments, the study was able to obtain data that addressed the research questions comprehensively.

Reliability and validity were rigorously assessed to ensure the robustness of the research instrument. A pilot study was conducted with 50 students who met the inclusion criteria but were not part of the final sample. The pilot tested clarity of items, sequencing of questions, response options, and completion time. Feedback from participants led to minor revisions in wording to improve readability and reduce ambiguity. Internal consistency of the questionnaire was evaluated using Cronbach's alpha, with coefficients exceeding the recommended threshold of 0.70, confirming satisfactory reliability. Construct validity was established through expert review, with specialists in educational technology and learning analytics evaluating the instrument for alignment with research objectives and theoretical frameworks. Content validity was further reinforced by grounding questionnaire items in established literature on personalized learning, learning analytics, student engagement, and academic achievement.

The study covered the under-graduate students of Higher Educational Institutions. Participants were subjected to a purposive sampling to ensure that they were directly involved with the objectives of the research, especially if they had experience with learning analytics applications and/or AI-driven personalized learning platforms (Zahoor, Khalil, & Faisal, 2025). The final number of respondents was 500 students from various subjects including education sciences, social sciences, natural sciences and humanities. The participants met the following criteria: enrolled in an undergrad program for 1 year or more, and had experience with AI used in or supported by learning environments. This allowed respondents to have adequate exposure to the constructs being studied (Younas, et al., 2022).

The finished instrument was, therefore, reliable and valid for large scale administration. The quantitative data were analysed using descriptive statistics (e.g. means, demographic data), and inferential statistics (e.g., correlation, regression analysis) were used to examine the relationships between personalized learning, learning analytics, student engagement, and academic achievement. Differences between disciplines and types of institutions were tested by ANOVA. The 30 students from the survey were used in the semi structured interviews to collect the qualitative data. The interviews addressed the students' experiences with AI-powered

personalized learning and learning analytics, looked at students' perceived advantages, disadvantages, and ethical issues. Qualitative data was analysed using thematic analysis as outlined by Braun and Clarke (2006) through 6 phases.

In conclusion, the methodology adopted the mixed methods' design, carefully developed and validated instrument, purposive sampling, and rigorous data collection procedures to allow for a comprehensive evaluation of the concept of personalized learning through the use of AI and learning analytics. The reliability and validation aspects of the designs helped to enhance the trustworthiness of the results obtained, and the sampling process helped to normalize the findings which showed different institutional settings. It allowed the researchers to collect empirical data on how AI powered personalized learning and learning analytics affects student engagement and academic performance in the context of the Higher Education sector in Pakistan.

Descriptive Analysis

The descriptive analysis presents an overview of the demographic information of the respondents and the answers they gave to constructs of personalized learning through artificial intelligence (AI), learning analytics, student engagement, and academic achievement. The sample of universities included 500 undergraduate students from public and private universities of Punjab, Sindh and KPH. These included 52% female, 48% male, with the majority in the age group 18-25. When broken down by disciplines, 35% of the respondents reported having concentrations in education sciences, 30% in social sciences, 20% in natural sciences and 15% in humanities.

AI enabled personalized learning environments showed relatively high levels of engagement, with mean scores of 4.12 (SD = 0.68), suggesting high levels of involvement in adaptive pathways and personalized feedback. Further, learning analytics received positive results (M = 3.95; SD = 0.72), indicating that students appreciated data-based feedback, and predictive analytics information regarding performance. Self reported GPA (M = 3.87, SD = 0.65, range 3.5 - 4.5) and formative assessment performance (M = 3.87, SD = 0.65, range 3.5 - 4.5) were also increased. The results agree with the study by Chen et al. (2020), who commented that personalized learning via AI has a positive effect on motivation and learning.

Table 1. Descriptive Statistics of Key Constructs

Construct	Mean	SD	Minimum	Maximum
Personalized Learning (AI)	4.12	0.68	2.10	5.00
Learning Analytics	3.95	0.72	2.00	5.00
Student Engagement	4.05	0.70	2.30	5.00
Academic Achievement	3.87	0.65	2.20	5.00

As seen in the table, AI based personalized learning had the highest mean score therefore showing high level of student satisfaction. Academic achievement scores were positive, though somewhat lower, indicating that there is evidence of high engagement and evidence that achievement outcomes need sustained support.

Inferential Analysis

To analyze the relationship between personalized learning, learning analytics, student engagement and academic attainment, a method called inferential statistics was used. The relationships between personalized learning, student engagement and learning analytics, academic achievement were found to be significant and positive based on the Pearson correlation analysis ($r = .68$, $p < .01$ and $r = .61$, $p < .01$, respectively). Data supports the conclusion that students who had the opportunity for personalized learning were more engaged, and those who had the chance for learning analytics had improved academic outcomes.

Three methods of statistical analysis were employed: regression analysis was used to assess the predictive power of personalized learning and learning analytics on academic achievement. The model was statistically significant ($F(2, 497) = 72.45$, $p < .001$), explaining 39% of the variance in academic achievement ($R^2 = .39$). Personalized learning was the single most important one ($\beta = .41$, $p < .001$), followed by learning analytics ($\beta = .35$, $p < .01$). These results support the findings of both constructs having a statistically significant impact on achievement, with personalized learning having the strongest impact.

Disciplinary differences were examined using ANOVA. Results indicated significant variation in student engagement across disciplines ($F(3, 496) = 9.87, p < .001$). Post-hoc comparisons revealed that education sciences and natural sciences students scored significantly higher in engagement compared to humanities and social sciences students. No significant differences were observed in academic achievement across disciplines, suggesting that while engagement varies, achievement outcomes are more evenly distributed.

Table 2. Regression Analysis Predicting Academic Achievement

Predictor	β	t	p
Personalized Learning (AI)	.41	8.72	<.001
Learning Analytics	.35	7.15	<.01
R^2	.39		

The regression model further suggests that the influence of personalized learning and learning analytics are significant on academic achievement, and the influence of personalized learning is higher than that of learning analytics: the students at the private universities reported higher engagement levels, while the ones at the public universities reported lower engagement levels. This disparity could also signify the wall-setting differences in access to AI supported platforms and analytics utilized in private institutions, evidencing infrastructural differences in the higher education system in Pakistan (Iqbal & Bhatti, 2022).

Both the descriptive and inferential analysis clearly emphasize a few important points. First, the engagement observed in the Pakistani students with AI enabled personalized learning environments resonates with the benefits of motivation provided by adaptive paths and AI feedback. Secondly, learning analytics can have a profound impact on improving students' learning performance via predictive analytics and intervention. Third, even with regard to achievement, personalized learning has a greater impact than analytics, educating is a personalized endeavour. Fourth, disciplinary differences in engagement reveal disparities in accessibility of AI supported learning among different disciplines, favoring technical disciplines. Fifth, some institutional differences suggest greater availability of AI and analytics tools in private universities than in public ones, and public institutions are challenged with infrastructure (Faisal, et al., 2023).

The results are consistent with Siemens (2013) finding that adaptive pathways are improved through learning analytics and with Fredricks et al (2004) finding that engagement is a key element to achievement. They further back up Floridi et al. (2018), who claim that moral concerns should be brought to bear when using artificial intelligence especially wherever there are access inequalities. The outcomes highlight the need to incorporate personalized learning and learning analytics into programs and policies to foster equity and effective implementation.

Qualitative Analysis

The purpose of the qualitative strand in this study was to add a depth to the quantitative findings and learn more about the students' experiences of personalizing their learning through artificial intelligence (AI) and learning analytics, and how those experiences contributed to their engagement and academic outcomes (Younas, et al., 2022). The 30 (under the pie charted numbers) undergraduate students in the survey who satisfied the criteria of the suggestible samples were chosen in purposive sampling to perform semi structured interviews. Thematic analysis was used based on the six-phase approach described by Braun and Clarke (2006): familiarisation with the data, initial coding, searching for themes, reviewing themes, defining and naming themes and finally, producing the analysis report.

Theme 1: Adaptive Pathways and Individualized Feedback

The implementation of AI as a tool for personalized learning journeys using adaptive technology was by far the most consistent response from students (Younas, et al., 2023). A significant number of AI-powered platforms reportedly increased or decreased the level of challenge to the student based on their work, allowing the student to work at their own speed. One such benefit was received by the fact that individualised feedback was seen as a key strength – AI systems gave students instant feedback on mistakes and additional steps they could take for some improvement. This theme respects that of Chen et al. (2020) which states that “adaptive pathways foster motivation and engagement”.

Adaptive pathways and individual feedback ensured an individual sense of ownership over learning which raised behaviour and cognitive engagement. There was a boost of confidence in being able to master content, leading to higher academic achievement.

Theme 2: Data-Driven Insights and Predictive Support

Learning analytics technology proved to be a key enabler to understanding performance trends and to its potentially predictive role. Students reported that analytics dashboards assisted them to keep track of progress, pinpoint areas for improvement, and establish targets. Predictive risk notifications for underperformance were found to encourage a few participants to make changes to their study practices. This is a theme with which Siemens (2013) agreed – the role of analytics in making proactive interventions happen.

Data-driven insights improved emotional participation by calming fears and instilling control. Predictive support was an important factor in achievement because it allows for timely interventions and an appropriate study strategy.

Theme 3: Enhanced Motivation and Engagement

For most students, personalised learning with AI was found to be more engaging than traditional learning. To increase motivation, interactive content, gamified assessments and adaptive feedback were mentioned. This was very evident with emotional commitment, as pupils were enthusiastic and enjoyed their learning experiences which were aligned to their interests. This theme lends to support the work of Fredricks et al. (2004) who defined engagement as behavioural, emotional and cognitive commitment.

Improved motivation resulted in more sustained engagement in behaviour - students' engagement in tasks increased and was more persistent. This helped to enhance student achievement, including in formative assessments.

Theme 4: Equity and Access Concerns

Although the students had positive experiences, there were concerns about equity and access. There was a gap between participation from public universities and private institutions in terms of the availability of AI enabled platforms. They identified a few gaps in internet access as well as device availability that interfered with them accessing personalized learning. The theme aligns with the focus on fairness and inclusivity of AI adoption put forward by Floridi et al. (2018).

Systemic barriers to engagement and achievement are addressed by equity concerns. AIs and the use of data can improve learning; however, there is a risk that inequalities of access will intensify learning inequalities.

Theme 5: Ethical Awareness and Data Privacy

Students pointed to ethical concerns with AI and analytics, especially regarding privacy of the data. Some of the participants warned of data storage issues, who has access and how - note resistance to the use of their learning data. Some have underlined the need to be transparent about algorithmic decision-making. This is consistent with a study by Jobin et al. (2019) which noted the concerns about AI ethics around the world.

Ethical awareness and sensitivity made a difference to emotional engagement as some students were unsure about whole-heartedly adopting AI platforms. Ensuring student privacy is crucial to maintain trust and improving the benefits of personalized learning.

Theme 6: Faculty Training and Institutional Support

Students observed that teachers' knowledge and readiness were influential with regard to the effectiveness of AI-supported personalized learning. As for some teachers, they were trained on using AI instruments, and for the students, their experience was smoother and their feedback was valuable (Makhdom & Khanam, 2021). A lack of faculty training resulted in underutilization of the AI features, however. It is in line with the observation of Iqbal and Bhatti (2022) on the significance of digital literacy amongst teachers.

Faculty training support, engagement are key factors in engagement and achievement. Power of AI and analytics is not being utilized effectively.

Table 1; Summary of Qualitative Themes

Theme	Key Insights		Impact on Engagement and Achievement	
Adaptive Pathways & Feedback	Tailored responses	learning, immediate	Increased confidence, stronger cognitive engagement	

Theme	Key Insights	Impact on Engagement and Achievement
Data-Driven Insights	Progress monitoring, predictive alerts	Reduced anxiety, improved study strategies
Enhanced Motivation	Interactive content, gamified assessments	Sustained behavioural engagement, improved formative performance
Equity & Access Concerns	Disparities in infrastructure and connectivity	Risk of inequality, constrained engagement
Ethical Awareness	Concerns about privacy and transparency	Cautious emotional engagement, need for trust
Faculty Training & Support	Instructor readiness influences AI integration	Mediates effectiveness, enhances achievement

Not only does the qualitative results support the quantitative results; these results also further illustrate the qualitative finding on how students accessed AI support personalized learning and learning analytics. Systems of high coverage on quantitative data and qualitative themes of adaptive pathways and individualised feedback and predictive support were found to be the vehicles through which these were evidenced in achievement. Qualitative results indicated issues of equity, privacy, and faculty Readiness that present barriers to the potential of integrating AI into the school library.

These results indicate that personalized leaning enabled by AI and learning analytics can deliver benefits to student engagement and achievement, but these are not factors which have to be neglected if implementing the use of these technologies is to be successful; ethical issues arise along with structural and system challenges. To harness the potential of AI in higher education, it is crucial to integrate it into college and university programs, make it accessible to everyone equitably, protect the privacy of data, and invest in educating faculty.

Findings

The findings of this study demonstrate the significant impact of personalized learning through artificial intelligence (AI) and learning analytics on student engagement and academic achievement in higher education institutions in Pakistan (Makhdom, et al., 2022). Quantitative results revealed that students reported high levels of engagement in AI-enabled personalized learning environments, with mean scores of 4.12 on a five-point scale. Learning analytics also scored positively ($M = 3.95$), indicating that students valued data-driven feedback and predictive insights. Academic achievement, measured through self-reported grade point averages and formative assessment performance, showed improvement ($M = 3.87$). Correlation analysis revealed strong positive associations between personalized learning and student engagement ($r = .68, p < .01$), as well as between learning analytics and academic achievement ($r = .61, p < .01$). Regression analysis confirmed that both personalized learning and learning analytics significantly predicted academic achievement, with personalized learning exerting stronger influence ($\beta = .41, p < .001$) compared to learning analytics ($\beta = .35, p < .01$).

Qualitative results indicated six key themes which echoed quantitative results: the importance of individualized feedback and pathways to adaptation; data-based insights and predictive support; increased motivation and engagement; equity and access challenges; ethical awareness and data privacy; and faculty training and institutional support. Feedback that is tailored to the pupil was consistently high quality and supported pupil confidence and engagement in learning as was adaptive pathway. Learning analytics received predictive support and intervention of "just in time", and study strategies were used to target the appropriate study area. Meanwhile, students discussed issues of equity, access and data privacy, particularly for public universities with poor infrastructure. Another key variable highly related to the effectiveness of How2AI was faculty readiness, with trained teachers playing a crucial role in ensuring a smooth integration of the AI tools. The results from these combined together are a full picture of how personalized learning (PL) with AI and LA affect engagement and achievement as well as identifying overall areas for concern. (Younas, et al., 2022)

Discussion

The findings contribute to the global discourse on AI in education by situating Pakistan within emerging debates on personalized learning and learning analytics. The high levels of engagement reported by students align with Fredricks et al. (2004), who conceptualized engagement as behavioural, emotional, and cognitive involvement in learning activities. Personalized learning through AI enhanced motivation and ownership, translating into sustained behavioural engagement and improved academic

performance. These results also support Chen et al. (2020), who emphasized that adaptive pathways and individualized feedback are central to effective AI-enabled learning environments.

The potential of learning analytics in making decisions about academic performance underscores the importance of utilising data to make better decisions about learning. As Siemens (2013) suggested learning analytics offer opportunities to support alive learners by sending alerts 'in time' and offering coaching towards good performance; the results confirm that predictive alerts and monitoring of students' progress led to valuable changes in the way students' study. However, if the majority of the weight is placed on personalized learning, rather than on analytics, then the importance of personalizing learning experiences is most critical in improving achievement .

There were important contextual issues identified seen from the qualitative themes. Systemic disparities between public and private institutions have been accentuated by equity and access issues, which expose the common limitation in the higher education system in Pakistan. Floridi et al., (2018) stressed the need for the use of AI to be fair and open, with the results showing that inequitable access could widen the educational gap. Adoption extends beyond these matters, however, in terms of ethical considerations and data privacy. However, other issues impact adoption: Students are aware that their data is not used or stored according to their values for privacy. The data corroborates the growing concerns with ethics in AI cited by Jobin and al (2019) across the globe to ensure trust in AI enabled learning environments.

The ways in which faculty were trained and the support provided by the institution proved important factors in achieving effective outcomes. Iqbal and Bhatti (2022) pointed out the role of AI literacy for educators and the results show that when educators are trained to use AI tools, it allows them to better integrate the development, whereas for those not trained, the integration of the tools is not smooth. Iqbal and Bhatti (2022) emphasized the role of digital literacy among educators, with the findings highlighting that an AI tool is integrated smoothly by educators who are trained to use it, while this integration ability is less by the non-trained ones and AI tools are underused in them. This highlights the importance of sustained investments in the trainings of faculty and institutional capacity building. The results reveal the importance of the institutional context, the design of the curriculum and ethical issues in the way the AI readiness and literacy of each learner is defined . The findings emphasize the importance of embedding AI education into educational systems for practical use, ensuring easy access to AI, safeguarding privacy of data, and equipping teachers with the skills to teach AI .

Conclusion

The study provides more insights into the role AI and LA in personalized learning on learner engagement and learning performance in the HE system in Pakistan. The quantitative results showed high level of engagement and higher achievement: individual learning and individual learning analytics had a more tangible impact on quantitative results. Qualitative themes highlighted processes that explained these results and issues of inequity, access, privacy and faculty preparedness (Younas, Taj, Khan, Hussain, Makhdum & Khan, 2023; Naz, Elahi, Shah & Makhdum, 2021).

The study concludes that AI-enabled personalized learning and learning analytics substantially enhance student engagement and academic achievement, provided that systemic barriers and ethical concerns are addressed. Successful implementation requires embedding AI literacy into curricula, ensuring equitable access across institutions, safeguarding data privacy, and investing in faculty training (Maria & Makhdum, et al., 2025). These measures will not only enhance learning outcomes but also contribute to inclusive and equitable education, aligning with Sustainable Development Goal 4 (SDG-4).

The findings suggest that the education higher institutions have come a long way in adopting AI in the country, however, there is a need for further investments in these institutions, policies that address the context at hand, a strong support system and collaboration among all stakeholders for long-term success. By tailoring the learning experience and learning analytics, higher education institutions can incentivize student centred learning space, which is expected to increase student interest and activity, and prepare students for outcomes in academic and works environments which are increasingly smart, technology enabled.

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