



The Changing Architecture of Learning: Examining how Artificial Intelligence is Reshaping Educational Practices and Student Learning

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ABSTRACT

The present study examined the changing architecture of learning by investigating how Artificial Intelligence was reshaping educational practices and student learning among university students in Pakistan. The study was significant because the rapid integration of Artificial Intelligence into higher education was transforming traditional approaches to teaching, learning, information access, feedback, and academic support, while empirical evidence regarding its broader influence on educational practices and student learning remained developing, particularly within the Pakistani higher-education context. A quantitative, cross-sectional research design was adopted, and data were collected from 447 university students from higher education institutions in Punjab and Sindh, Pakistan. A structured and adopted questionnaire was used to measure Artificial Intelligence, AI-supported educational practices, and student learning through Likert-scale items. Data were collected through an online Google Forms questionnaire that was distributed electronically to university students, after which the responses were organized, coded, and prepared for statistical analysis using SPSS. The data were analyzed through descriptive statistics, reliability analysis, Pearson correlation, multiple linear regression, independent-samples t-test, one-way ANOVA, and Tukey HSD post-hoc analysis. The findings demonstrated a strong positive relationship between Artificial Intelligence and educational practices and further showed that Artificial Intelligence significantly contributed to the prediction of AI-supported educational practices. The results also indicated meaningful differences in Artificial Intelligence, educational practices, and student learning across gender and age groups, suggesting that students' experiences with AI-supported learning were not uniform across demographic characteristics. Overall, the study concluded that Artificial Intelligence was becoming an important component of the changing educational environment and had considerable potential to support more flexible, interactive, personalized, and student-centered learning practices. The study emphasized the importance of responsible AI integration, AI literacy, appropriate pedagogical strategies, equitable access, and continued human guidance to ensure that technological advancement contributes effectively to meaningful student learning.

Introduction

Artificial intelligence has become an important part of modern education. It has transformed the way students and educators access information, share knowledge, and evaluate learning materials.

Unlike other digital technologies, AI can generate content. It personalizes learning, crafts feedback, analyzes learners, and builds a bridge between learners and technology. This explains the rapid integration of AI in intelligent tutoring systems, adaptive learning, learning analytics, and automation of assessments. It explains the rapid integration of generative AI in learning. This results in a shift from offering instruction in a standardized manner to a more personalized learning process (Wang et al., 2025).

The educational use of AI has begun to reshape both teaching and learning. Teachers have an AI assistant in the creation of learning resources. AI can assist teachers in planning lessons, offering feedback, and assessing students. In contrast, AI can offer explanations, examples, frameworks, and active learning to students. However, AI operates optimally when pedagogical strategies complement its use, and teachers engage with the technology, and students are active participants (Zhong & Zhao, 2025). AI also presents pedagogical problems such as a lack of appropriate teaching frameworks, automation overreliance, a lack of autonomy, privacy, bias, equity, and integrity in learning. AI should be integrated in a pedagogy-first approach where education is prioritized and ethical concerns are addressed (Díaz et al., 2026).

AI also has the ability to positively change student learning. Recent studies show that learning or assisting students with learning tasks can improve students' learning, motivation, and engagement, and positively affect students' problem-solving skills and reasoning if instructions are properly designed. Although AI unrestrictedly creates opportunities for online learning and teaching, the context in which the pedagogy is designed, taught, and assessed will affect the benefits of AI in education. Therefore, the impact of AI in education should be studied empirically (Leon et al., 2025).

Artificial Intelligence in Education

Artificial Intelligence (AI) in education uses computational systems to process cognitive activities in teaching, learning, assessment, management, and decision-making in education. Examples of AI in education include intelligent tutoring systems, learning management systems, automated assessments, learning analytics, recommendation systems, educational chatbots, and generative AI. Processing, recognizing patterns, content creation, providing feedback, prediction, and adaption of learning materials are some functional activities of AI in education that make AI a pillar in the contemporary education system (Roll & Wylie, 2016).

AI in education has the potential to redefine the interactions among the stakeholders in the teaching, learning process, and learning content. With the use of AI technology, learning systems can provide quick feedback, recommend resources, and practice activities, and can deliver differentiated learning content and scaffolded instruction. The adaptive learning, intelligent tutoring, learning analytics, and generative AI technologies build upon each other (Guarino et al., 2024). AI has far reached implications and possibilities beyond the provision of additional educational resources, as it has the potential to redefine the organization of teaching and learning activities.

The educational value of AI lies in the design of the systems in which AI integrates pedagogy and human systems. Use of AI without pedagogy and human design will not ensure meaningful learning; quality instruction, purposeful design of tasks, formative and summative assessments, and pedagogy will play a role in the learners' engagement. Díaz and Nussbaum (2024) point out that AI-augmented education must have pedagogical frameworks, whereas human-centered approaches stress on the importance of reliability, trust, safety, and control in addition to human involvement. From this perspective, AI technology can enhance education as a partner technology of teachers and students complementing pedagogy transforming learning processes.

As (Strickland et al.) argue, the presence of AI in teaching represents little more than "neither an existential threat to teachers nor an opportunity for them to be supplementary to the learning process". From that viewpoint, AI cannot design learning processes and make pedagogical decisions, and hence, AI may be useful for educational ends, but it remains a supporting tool for teaching, controlled by and integrated with teachers, and in conjunction with students and educational practices (Pedro et al., 2019).

AI-Supported Educational Practices

Practices of AI-assisted learning include AI-generated aids for the planning of lessons, personalized education, intelligent tutoring systems, computers with the ability to grade and/or evaluate assignments, learners' self-directed activities, intelligent assistants

for learners, and systems for monitoring learners. As AI is being integrated into instructional systems, education is beginning to change more so; moreover, AI is projected to impact teachers' activities and learners' contact with content, activities, interactions, and processes of instruction (Dönmez, 2024).

During the planning of lessons, instructors stand to benefit from AI in the generation of teaching aids, assessment instruments, and feedback. Teachers are able to focus on planning and teaching without the burden of tedious work. AI should not generate content in a vacuum. Human discretion is needed to vet such content, since it may contain prejudice and/or be incorrect and/or incomplete. Therefore, the ethics of teaching and learning guided by appropriate discretion should drive the integration of teaching assisted by AI (Aimicheva et al., 2025).

Learners, on the other hand, benefit from the availability of immediate feedback and assistance in learning activities, as well as from systems for the generation of learning aids and explanations. Students may use assistants to facilitate the generation of alternative explanations to clarify concepts, offer suggestions for work improvements, and develop solutions to problems (Liao, 2025).

Some studies show that utilizing AI in the classroom may help students' academic performance and help them develop their critical thinking, but it may diminish their overall cognitive engagement (Čolić et al., 2025). This is especially the case with students who become too reliant on AI. To that end, it is best to utilize AI within the context of the classroom to encourage students to engage meaningfully with the content. The use of AI in education has the ability to change teaching practices and how teaching activities are planned, carried out, monitored, and reviewed (Gudonienė et al., 2026). With AI's ability to personalize, support, generate resources, assess, and analyze educational data, it may push for more advanced, interactive, and informative education (Wang et al., 2024). How AI is utilized in education, along with the design and engagement of teachers and students, is the primary factor in how much teaching and learning practices change (Mousa, 2025).

Student Learning

Student learning is the main educational goal in this research, and it describes how students acquire, process, and develop knowledge and skills, attitudes, and competencies. In AI-based teaching, learning expands beyond traditional measuring of learning outcomes such as exam grades, to include cognitive outcomes, problem-solving, critical thinking, motivation, engagement, AI literacy, and autonomous learning. Recent studies have indicated that the use of AI in education has positive effects on cognitive and emotional learning outcomes; however, the effects may differ in different educational contexts and in the design of the intervention, length of the intervention, and the different methods of assessment used to gauge learning (Fry et al., 2008).

The use of AI in learning can enhance the flexibility of educational support in terms of availability, timeliness, and personalization. Various AI systems can deliver feedback, step-by-step explanations, study materials, and practice activities focused on a specific learning goal. This can assist learners in more effectively addressing learning issues. Several AI-based interventions have indicated that AI-supported learning can enhance problem-solving, motivations, and higher learning, and can encourage more autonomous learning (Lee & Anderson, 2013). Thus, AI has the ability to influence learning beyond the basic provision of knowledge.

Increased access to AI does not guarantee deeper or more meaningful learning. Learning that is overly reliant on AI is likely to be shallow because of the lack of justification, evaluation, and the construction of autonomous knowledge. AI-based learning systems depend on learners actively engaging, critically evaluating, and creating robust learning experiences (Arends & Kilcher, 2010). AI can be a fantastic support system when the students are responsible for processing and interpreting information, making decisions, and developing their knowledge.

AI can theoretically augment learning when adjusting how students receive learning input, how students practice their skills, and how students receive feedback on their work with learning content. The use of personalized instruction, adaptive design, on-demand feedback, and learning support can enable students to learn how to successfully identify and overcome the challenges of learning. AI-supported learning initiatives have been reported to enhance learning outcomes, motivation, involvement, and advanced learning outcomes. When AI is integrated into learning contexts (Darling-Hammond, 2008), it can provide more intelligent and interactive frameworks of learning.

The use of AI in learning is the new foundation of how students learn. AI can create a custom learning environment and provide students with the tools and feedback needed to complete learning tasks guided by assistance and problem-solving support. Recent

reviews and experimental researches show positive learning effects, but emphasized that outcomes depend on responsible implementation and right pedagogical conditions (Carini et al., 2006). This indicates that the educational impact of AI should be viewed beyond technology availability and should be related to the degree of integration of AI in meaningful learning processes.

Research Objectives

- To examine the relationship between Artificial Intelligence and educational practices.
- To assess the relationship between AI-supported educational practices and student learning.
- To determine the effect of Artificial Intelligence on student learning outcomes.

Problem Statement

Artificial Intelligence (AI) is transforming education with features such as personalized learning, automated feedback, intelligent tutoring, content generation, and adaptive learning. Despite this rapid growth, our empirical understanding of AI's impact on learning and pedagogy lags behind. Most research focuses on the capabilities and positive effects of AI. However, the effects of AI adoption on educational practices and teaching, and the subsequent learning outcomes have received significantly less attention.

There's much room for improvement as previous studies identified issues related to pedagogical foundations, short-term interventions, small sample sizes, fluctuating research methodologies, and insufficient long-term research on learning outcomes (Takona, 2024). However, several studies have shown how generative AI enhance academic performance and learning. There's still a lack of understanding on how specific AI-based learning practices influence student learning across all learning environments. Initially, the concentrated AIED research in the same Education regions calls for more studies (Katsamakos et al., 2024). This study aims to fill this gap by exploring how AI, AI-based educational practices, and student learning relate, and how lowering the barrier to educational technology (the use of AI in education) can positively influence student learning.

Significance of the Study

This study contributes to the existing literature by improving understanding of how artificial intelligence influences teaching practices, learning methods, and student outcomes in an increasingly digital educational environment. This study will help academia better understand how AI transforms educational processes and aids student learning. The current trend is the merging of generative AI, intelligent tutoring systems, adaptive learning, automated feedback, and more. Educators can use the study's findings to help them effectively incorporate AI to enhance instruction, student engagement, personalized learning, and progress in their academic growth. Policymakers and institutions use the study to help incorporate AI to help develop policies for teacher professional development and responsible integration of educational technology, as well as strategies that maintain educational balance and student autonomy. For students, understanding the pros and cons of AI can influence them to critically and consciously use AI for learning. Finally, this study provides a baseline for future research to explore the possible transformation of the teaching and learning paradigm brought on by AI. This study also contributes to the growing discussion of AI's role in education.

Literature Review

Artificial Intelligence in Education

Artificial Intelligence (AI) in education describes the application of technologies modeled on various functions of human intelligence in teaching, learning, assessment and other cultural processes. Such functions include various levels of natural language processing, pattern recognition, prediction and recommendation, automated feedback, context generation and intelligent participation. AI, therefore, encompasses numerous innovative technologies as evidenced by adaptive learning systems, intelligent tutoring systems, analytics, educational chatbots, and automated assessment and more recently by generative AI applications. AI is steadily gaining importance, particularly in supporting individualized, flexible and impactful learning, thereby enabling learning environments to provide flexible, learner-centered instruction, rather than standardized learning (Lameras & Arnab, 2021).

Generative AI has fundamentally altered the role of AI in education. The systems can generate explanations, examples, questions, summaries, feedback and other educational content. There is now preliminary evidence that the use of AI technologies can lead to improvements in learning outcomes and higher-order skills. Personalized and adaptive AI systems can create customized learning

pathways and offer highly interactive AI-based educational supports (Alam, 2021). Yet, these advantages will only be realized with purposeful integration of AI in learning. Simply making the technologies available does not guarantee quality learning.

Some research shows engagement and disengagement among students using generative AI, showing that the educational effects of generative AI are not always positive (Pham & Sampson, 2022). As such, integrating AI in an educational context requires responsible deployment of AI alongside teaching practices, careful supervision by teachers, critical evaluations, and active participation by students. AI should be designed in a way that is complementary to teaching practices and uses the knowledge of both teaching and learning (Gocen & Aydemir, 2020). Some research shows engagement and disengagement among students using generative AI, showing that the educational effects of generative AI are not always positive (Khosravi et al., 2022). As such, integrating AI in an educational context requires responsible deployment of AI alongside teaching practices, careful supervision by teachers, critical evaluations, and active participation by students. AI should be designed in a way that is complementary to teaching practices and uses the knowledge of both teaching and learning (Knox, 2020).

AI-Supported Educational Practices

The use of AI in education involves using artificial intelligence to help or change how and what is taught. Examples include personalized instruction, automated feedback, AI-developed content, adaptive systems, intelligent tutoring, educational analytics, assessment aid, and conversational systems. These practices go beyond the adoption of technology. They incorporate AI in teaching and learning. Interactive learning technology uses AI for flipped, project, and problem-based learning and scaffolded activities and feedback. AI can also support personalized instruction by responding to the individual learning needs and providing differentiated resources and practice opportunities. However, the overall effectiveness of AI systems in teaching and learning is determined by the quality of the AI systems and the supporting pedagogy (Aimicheva et al., 2025).

AI-based educational systems support teachers by automating several tasks in lesson planning and building, assessment, and initial feedback and by adapting and customizing content (Nikolopoulou, 2026). AI reduces teachers' time on several routine tasks allowing them to focus on supporting learners through mentoring, instruction, and providing support for higher-order learning activities. Although AI-based systems can help automate some of the teaching tasks, teachers will continue to be a necessity due to the often inaccurate and unfair information that may be in AI generated content. AI-based educational systems should be implemented with oversight to support, direct and protect learners from the content, and scaffold the instruction (Liao, 2025). Although AI-based educational systems have considerable potential, evidentiary support for their use is limited and fragmented. Studies differ in length of the interventions, user groups, and outcome measures.

Reviews have reported analysis limitations such as short intervention lengths and non-standardized methods, small sample sizes and lack of longitudinal evidence (Kusmawan, 2023). Experimental research has focused on university students and direct engagement with generative AI systems. Thus, more empirical research is necessary to determine if the adoption of AI actually redesigns teaching and learning through new modalities. research is necessary to determine if the adoption of AI actually redesigns teaching and learning through new modalities. The incorporation of AI has the potential to impact each phase of an instructional plan – from the design of instruction to the delivery, personalization, assessment, and evaluation of learning (Kaushica, 2026). The potential for misalignments of technological offerings and appropriate planning may restrict the impact of pedagogy on the design of instruction and the delivery, personalization, assessment, and evaluation of learning (Wan et al., 2025).

Student Learning

Modern learning technologies can offer students ways to gain access to information, understand concepts, and practice new skills. They can help students study by providing explanations, examples, feedback, and creating learning activities. The integration of learning technologies has been known to improve student engagement, and improve problem solving ability and digital skills. The presence of technology has been observed to not always positively impact student learning. Instant access to answers can lead students to become overly dependent on technology which tends to inhibit student learning of new concepts to a substantial extent. This makes problem-based learning, student participation, and learning activity design critical to all teaching technologies (Vermunt & Vermetten, 2004).

Technology integrated in learning and teaching collaboratively with teaching pedagogies and student participation can create a learning environment that is effective and interactive. Technology has penetrated most aspects of education and has positive implications for active learning, critical engagement, and student growth. Learning is positively impacted by the ability to self-learn, easy access to learning materials, gaining feedback on learning activities, and the ability to collaborate on learning tasks.

Integration of technology in learning affords students the opportunity to optimize their learning and motivates students to take control of their learning (Elton & Laurillard, 1979).

Research Gap

Despite the rapidly expanding literature on Artificial Intelligence in education, an important empirical gap remains regarding how AI is simultaneously reshaping educational practices and influencing student learning. Existing research has largely focused on specific AI technologies, particularly ChatGPT, and has examined outcomes such as academic performance, engagement, and higher-order thinking separately, while methodological limitations, short intervention periods, and concerns about assessment validity restrict conclusions regarding sustained learning effects (Lytras et al., 2024). At the same time, limited attention has been given to the pedagogical foundations through which AI transforms teaching and learning, with technological development progressing faster than empirical understanding of its educational impact (Akomodi & Abdullah, 2025). Research is also concentrated in particular geographical and educational contexts, especially China, the United States, and higher education. Therefore, the present study addresses the insufficient integrated evidence concerning the relationships between AI, AI-supported educational practices, and student learning, particularly whether AI integration is associated with meaningful changes in educational practices that contribute to improved student learning. Addressing this gap can provide a broader understanding of the changing architecture of learning and clarify whether AI represents a meaningful pedagogical transformation rather than simply another technological resource in education.

Hypotheses

H1: There is a statistically significant positive relationship between Artificial Intelligence and educational practices.

H2: Artificial Intelligence significantly predicts educational practices.

H3: There is a statistically significant difference in Artificial Intelligence use, educational practices, and student learning between male and female students.

H4: There is a statistically significant difference in Artificial Intelligence, educational practices, and student learning across different age groups or educational levels.

Methodology

Research Design

This study used a quantitative, cross-sectional survey design to investigate relationships surrounding Artificial Intelligence and how technologies drive education and how students learn. The primary data collection tool was a structured survey. The study variables were measured with Likert scale items that were converted to numerical values for analysis. The cross-sectional survey was appropriate because in this design, no experimental intervention was introduced and there was no tracking over a period of time. Using this design allowed the researcher to investigate perceptions and experiences as they occur in AI-enabled education and to determine relationships, predictors, and significant differences within various demographic groups. Other similar quantitative surveys have been used to study the integration of educational technologies and the AI skill gap.

Population

This study focused on students in the higher education system in the Punjab and Sindh provinces of Pakistan. The purpose of selecting these two provinces was to introduce as much diversity as possible in the higher education systems and to capture the different domains of university students' contact and engagement with AI. This population included students enrolled in both public and private universities and other institutions at different levels and in different specializations. Because of the nature of today's university studies, with students regularly using generative AI and related tools, online learning platforms and other educational technologies, students of higher education are the most appropriate population for this study.

Target Audience

University students studying undergraduate and postgraduate programs in Punjab and Sindh, Pakistan were the focus of this study. This included participants with access to digital educational resources and people who use learning resources that contain AI and other learning support technologies. Both male and female students from all fields were included to give examples of the different experiences and opinions surrounding the role of AI in education. The target audience was selected because students are

the primary users of AI technologies in educational activities that may include learning management systems and digital learning tools, AI in providing automated feedback, and the use of academic resources that integrate generative AI technologies. Study participants will provide evidence regarding the extent of AI integration in learning, and assessment of the impact of the integration of learning technologies in AI for education on the improvement of the learning process. It was important to consider students from different fields to analyze the scope of AI in education technologies beyond the fields of engineering and computer science.

Sampling Technique

The study used a non-probability convenience sampling method for recruiting students from Punjab and Sindh in Pakistan. This sampling method was used because the participants were chosen based on their accessibility, availability, and their willingness to participate during the data collection period. The questionnaire was posted to student groups, given to contacts at institutions, shared through online networks, and sent directly to participants. Study participants were informed about the study and encouraged to fill out the online survey at their convenience. The online format improved access to participants located in various different universities and disciplines. This study used convenience sampling, where respondents were not required to physically attend the university. The researcher was able to collect data from students with varying levels of exposure to AI-based technology and obtain some data on the relationships of Artificial Intelligence and AI-based educational technologies in conjunction with student learning.

Sample Size

The final sample for the current study was 447 participants from Punjab and Sindh universities in Pakistan. The data collectors collected and reviewed 447 questionnaires and included them in the data analysis. The sample size was sufficient for the analyses of the relationships of Artificial Intelligence, AI-based educational technologies, and student learning, as well as for the planned Pearson correlation, multiple linear regression, t-tests, and one-way ANOVA.

Data Collection

A structured questionnaire was used to determine artificial intelligence (AI) tool utilization, AI-supporting learning methods, and their impact on students. The questionnaire had sections on demographic details, AI, learning methods under AI's supervision, and their impact on students. Each question was answered on a five-point Likert scale (1-strongly disagree, 2- slightly disagree, 3- neither agree nor disagree, 4- slightly agree, 5- strongly agree). The questionnaires were distributed to students at universities in Punjab and Sindh using online platforms and student networks. The responses were gathered and downloaded to SPSS from Google Forms after data had been collected. The responses were checked for accuracy and arranged prior to data analysis in SPSS.

Data Analysis

The data were first entered into Microsoft Excel and then transferred to SPSS for analysis. Before analysis, the data were carefully checked to ensure that the responses were complete, properly coded, and suitable for the study. Descriptive statistics including means, frequencies, standard deviations, and percentages were used to analyze the respondent characteristics and study variables. Internal consistency of the three scale constructs of AI, AI supported educational practices, and student learning was assessed using Cronbach's alpha. Pearson's correlation was used to determine the nature and degree of association among the focal study variables. The contribution of AI to educational practices and student learning was evaluated using multiple regression. The t-test was used to compare the demographic groups, while one-way ANOVA was used to assess variables with three or more groups. Tukey's HSD was used to determine specific group differences whenever significant ANOVA results were obtained. The effects were considered statistically significant at $p < .05$. Magnitude, direction, and significance of the relationships and group differences were used for interpretation.

Table 1: Demographic Characteristics of Respondents (N = 447)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	241	53.9
	Female	206	46.1
Age	18–21 years	156	34.9
	22–25 years	184	41.2

Educational Level	26-30 years	74	16.6
	Above 30 years	33	7.4
	Undergraduate	278	62.2
	Master's	121	27.1
	MPhil/MS	34	7.6
Academic Discipline	PhD	14	3.1
	Social Sciences	104	23.3
	Business/Management	82	18.3
	Computer Science/IT	91	20.4
	Education	76	17.0
	Health Sciences	58	13.0
	Engineering	36	8.1
Geographical Area	Punjab	272	60.9
	Sindh	175	39.1
Previous AI Experience	Less than 1 year	87	19.5
	1-2 years	156	34.9
	3-4 years	128	28.6
	More than 4 years	76	17.0
Total Respondents		447	100.0

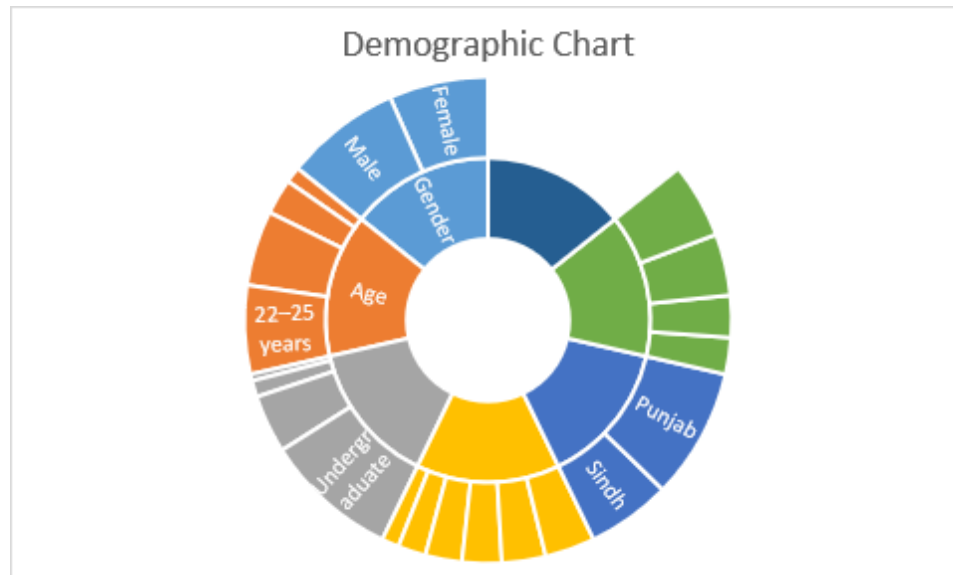


Fig. 1 Demographic Chart

Demographic analysis described 447 participants. Of that total, there were 241 male participants (53.9%) and 206 female participants (46.1%). The largest group of the sample, 41.2%, were between 22 and 25 years. The next largest group, 34.9% of participants, were between 18 and 21 years. The sample also contained 62.2% of participants who were enrolled at the undergraduate level. The Social Sciences (23.3%) were the largest group of participants among the academic disciplines, followed by the participants from Computer Science/IT (20.4%) and Business/Management (18.3%). Punjab's participants represented 60.9% of the sample, while Sindh represented only 39.1% of the sample. Most participants reported having 1-2 years' experience (34.9%) with Artificial Intelligence, and the next largest group of participants, 28.6%, reported 3-4 years' experience with

Artificial Intelligence. In general, the sample was(was) diverse along several dimensions (gender, age, education, academic discipline, location, experience with AI), and was suitable to study Artificial Intelligence, Artificial Intelligence in the context of teaching and learning, and the learning of students.

Table 2: Reliability Statistics and Descriptive Analysis of Study Variables (N = 447)

Variables	No. of Items	Cronbach's Alpha (α)	Mean	Std. Deviation
Artificial Intelligence	10	0.901	3.74	0.71
AI-Supported Educational Practices	12	0.918	3.81	0.68
Student Learning	10	0.887	3.79	0.70
Overall Scale	32	0.934	3.78	0.63

The analysis of reliability concluded that there was strong consistency among all the study factors. In the case of the Artificial Intelligence factor, the scale recorded a value of Cronbach's alpha was 0.901, while for the AI-Supported Educational Practices, the value was 0.918. In the case of the Student Learning factor, the value of Cronbach's alpha was 0.887. Overall, the 32-item scale of the instrument recorded an excellent Cronbach's alpha value of 0.934. As all values obtained were above the recommended minimum value of 0.70, the measurement tool was reliable to perform the analysis.

Table 3: Correlation Between Artificial Intelligence and Educational Practices (N = 447)

Variables	Mean	Std. Deviation	1	2
1. Artificial Intelligence	3.74	0.71	1	
2. Educational Practices	3.81	0.68	0.684	1

Note. Pearson correlation coefficient was used. $p < .001$ (two-tailed).

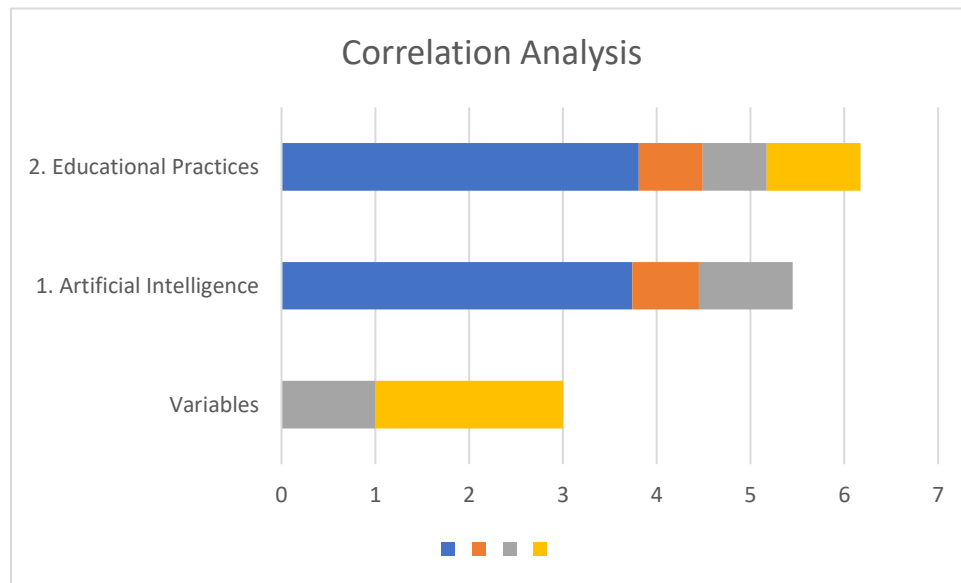


Fig.2 Correlation Analysis

There was a positive, strong, statistically significant correlation between Artificial Intelligence and AI-supported educational practices ($r = 0.684$, $p < .001$). More Artificial Intelligence corresponded to more AI-supported educational practices. The positive and statistically significant correlation provided support for H1. However, correlation should not be confused with causation, so the finding provided no evidence that Artificial Intelligence was changing the forms that educational practices took.

Table 4: Multiple Linear Regression Analysis of Artificial Intelligence Predicting Educational Practices (N = 447)

Predictor	B	Std. Error	Beta (β)	t	Sig. (p)
Constant	1.142	0.174	—	6.563	<.001
Artificial Intelligence	0.713	0.046	0.684	15.500	<.001

Model Summary: $R = 0.684$, $R^2 = 0.468$, Adjusted $R^2 = 0.467$, $F(1, 445) = 240.25$, $p < .001$.

Artificial Intelligence was a positive, significant predictor of AI-supported educational practices, and the multiple linear regression analysis supported H2. The model explained 46.8% of the educational practices and the other 53.2% was attributable to other factors. The overall regression model was statistically significant, $F(1, 445) = 240.25$, $p < .001$, so H2 was supported. The finding provided evidence that with greater Artificial Intelligence, more AI-supported educational practices were used.

Table 5: Gender Differences in Artificial Intelligence, Educational Practices, and Student Learning (N = 447)

Variables	Gender	N	Mean	Std. Deviation	t	df	Sig. (2-tailed)	Mean Difference
Artificial Intelligence	Male	241	3.82	0.68	2.561	445	.011	0.17
	Female	206	3.65	0.74				
AI-Supported Educational Practices	Male	241	3.88	0.65	2.324	445	.021	0.15
	Female	206	3.73	0.71				
Student Learning	Male	241	3.86	0.67	2.171	445	.030	0.14
	Female	206	3.72	0.73				

The results of the independent samples t-tests showed, in each of the three study variables, differences between men and women that were statistically significant. In each case, men scored higher than women. The men's mean scores for Artificial Intelligence, for example, was 3.82, as was the mean score for women, 3.65. Similarly, men's mean score for AI-based learning practices was 3.88 (women's was 3.73), for student learning, 3.86 (women's was 3.72). H3 was confirmed by the results.

Table 6: Differences in Study Variables Across Age Groups (N = 447)

Dependent Variable	Age Group	N	Mean	Std. Deviation
Artificial Intelligence	18–21 years	156	3.61	0.73
	22–25 years	184	3.78	0.68
	26–30 years	74	3.89	0.66
	Above 30 years	33	4.02	0.61
AI-Supported Educational Practices	18–21 years	156	3.69	0.71
	22–25 years	184	3.82	0.66
	26–30 years	74	3.94	0.63
	Above 30 years	33	4.08	0.58
Student Learning	18–21 years	156	3.67	0.74
	22–25 years	184	3.79	0.69
	26–30 years	74	3.91	0.65
	Above 30 years	33	4.05	0.60

Table 7: One-Way ANOVA Results Across Age Groups (N = 447)

Dependent Variable	Sum of Squares Between	df	Mean Square	F	Sig. (p)
Artificial Intelligence	9.842	3	3.281	6.789	<.001
AI-Supported Educational Practices	8.967	3	2.989	6.912	<.001
Student Learning	8.514	3	2.838	5.923	.001

Tukey HSD Post-Hoc

Dependent Variable	Comparison	Mean Difference	Sig. (p)
Artificial Intelligence	18-21 vs. 26-30 years	-0.28	.012
	18-21 vs. Above 30 years	-0.41	.003
	22-25 vs. Above 30 years	-0.24	.041
AI-Supported Educational Practices	18-21 vs. 26-30 years	-0.25	.018
	18-21 vs. Above 30 years	-0.39	.004
	22-25 vs. Above 30 years	-0.26	.032
Student Learning	18-21 vs. 26-30 years	-0.24	.026
	18-21 vs. Above 30 years	-0.38	.006
	22-25 vs. Above 30 years	-0.26	.038

According to the one-way ANOVA, in all three study variables, respondents differed significantly in Artificial Intelligence, AI-based learning practices, and student learning. In this case, the mean score for each of the variables rose with age, where respondents over the age of 30 scored the highest, and respondents between the ages of 18 and 21 scored the lowest. Tukey HSD post hoc analysis showed that the oldest respondents, over the age of 30, scored significantly higher in the three study variables than respondents who were between the ages of 22 and 25. The youngest respondents, between the ages of 18 and 21, also scored significantly lower than all other age groups. These results confirmed H4.

Discussion

This study examined the influence of Artificial Intelligence (AI) on education, learning, and service delivery among university students in Pakistan. The use of AI and related technologies in learning and teaching practices was found to be very supportive and highly positive ($r = .684$, $p < .001$), and the regression analysis indicated that AI impacted teaching and learning practices and accounted for 46.8% of the total impact. These outcomes indicated that AI was becoming more pervasive in the planning and conducting of teaching and learning activities beyond being just a supplementary technology. These outcomes were consistent with the findings of Imran et al. (2024) who concluded that the role of AI in learning and teaching would become more pervasive with respect to personalized learning, intelligent tutoring, assessment, and learning analytics, and related coverage and support.

The extent of AI's educational value was dependent on how it influenced teaching practices. Long et al. (2025/2026) reported that AI was most effective when integrated with interactive and active learning methods such as the flipped classroom, PBL (Project Based Learning), Personalized Learning, and ASOB (Adaptive Scaffolding of Ongoing Behavior). Similarly, Deng et al. (2024/2025) showed that Generative AI technology is able to support the academic process and foster motivation and higher-level cognitive skills. Thus, the findings of the present study confirmed that AI is able to support learning through the use of scaffolding, personalized feedback, guidance, and self-archiving resources; however, its positive contribution should be cautioned as it is not able to assure higher-level learning (Talpur et al., 2026).

As expected, strong differences between the two genders were identified, with male students reporting higher AI levels, AI supported educational practices and learning compared to female students. There were also differences in age and these were noted by older respondents having a higher mean score on the three variables. These may be explained by differences in access to technology and/or differences in self-assurance and experience from their academic or work backgrounds. However, these should not be perceived as differences in ability. Carolus et al. (2023), state that literacy of AI should be contextual and require the knowledge of how to use technology, critical thinking and analysis. This would suggest that the ability of a student to use AI would not be sufficient just by being exposed to it (Tawfik et al., 2024).

The overall results suggested that AI technology was changing the landscape of learning in that it supported models of learning which were more individualized, more flexible, more responsive, and more interactive. However, it should be noted that the cross-sectional nature of the research did not allow for a formal understanding of causation, and the results of the regression should not suggest that AI, in isolation, has the ability to alter educational behavior. This may also be impacted by the teacher, the support offered by the institution, and the teacher's digital infrastructure and resources. As such, AI should be understood as

supporting a range of educational activities, and should not be used as a substitute for teaching, and should be implemented with a commitment to critical thinking and AI literacy, privacy, equity, and with continued human oversight (Gulson et al., 2022).

General Conclusion

It is evident that Artificial Intelligence (AI) is affecting education at higher education institutions in Pakistan and its impact is expected to grow. There is a significant positive correlation between AI and educational practices. Regression analysis also revealed that AI influenced AI-enabled educational practices. There is an impact of AI on the planning, delivery and support of learning activities, enabling self-directed active learning, instant access to a variety of resources, learning activity promotion, supportive learning and instructional activities, and flexible learning. AI is an essential element of the changing educational environment, not just a technology among many.

The study concluded that during the use of AI-enabled education practices, some students experience positive effects, while some experience negative effects, and this is influenced by the students' gender and age. The changing learning environment combines technological development, educational practices, and the experiences of learners. Research revealed that integration of AI in education should be done in a responsible manner by pedagogical practices, digital competence and the critical evaluation of AI. AI integrates technology to support the practice of teaching and learning, and enables flexible, student-centered and interactive learning environments in higher education institutions in Pakistan.

Future Implications

In the future, universities are expected to make greater use of modern technologies to support teaching and learning. However, these tools should be used in a way that benefits students and supports effective learning. Students and teachers should be encouraged to develop digital skills and critical thinking to use technology responsibly. Universities should also provide training opportunities and clear guidelines to ensure that all learners have equal access to educational resources and support. AI should be integrated with equity in mind. Future policies should incorporate the use of AI in personalized learning, formative assessment, feedback, and collaborative or student-centered learning, while ensuring proper accountability. More research is needed to examine the long-term consequences of AI and cover the additional aspects of digital competence, institutional aid, teacher competence, and accessibility within the scope of AI and its integration in education. The focus should remain on achieving an ethical, inclusive, and pedagogically sound transformation of the education system to achieve learning outcomes.

References

1. Aimicheva, G., Shaikhanova, A., Iklassova, K., Tazabekova, P., Nazyrova, A., & Kadyr, Y. (2025). Fostering teachers' digital competence in ai-supported learning environments: Implications for interactive teaching and student achievement. *Applied Sciences*, 15(23), 12597.
2. Akomodi, J. O., & Abdullah, F. (2025). Development of AI in architectural education and the built environment. *International Journal of Recent Innovations in Academic Research*, 9(4), 92-97.
3. Alam, A. (2021). Possibilities and apprehensions in the landscape of artificial intelligence in education. 2021 International conference on computational intelligence and computing applications (ICCICA),
4. Arends, D., & Kilcher, A. (2010). *Teaching for student learning: Becoming an accomplished teacher*. Routledge.
5. Carini, R. M., Kuh, G. D., & Klein, S. P. (2006). Student engagement and student learning: Testing the linkages. *Research in higher education*, 47(1), 1-32.
6. Čolić, V., Sukić, E., & Anđelković, M. (2025). AI-supported learning methodologies: Theoretical review and empirical research on the educational process impact. *TEM Journal*, 14(4), 3714.
7. Darling-Hammond, L. (2008). Supports Student Learning. *Teaching for intelligence*, 91.
8. Díaz, B., Bekerman, Z., & Nussbaum, M. (2026). A Biological Learning Theory: How We Learn in the Era of AI. *Journal of Science Education and Technology*, 1-19.
9. Díaz, B., & Nussbaum, M. (2024). Artificial intelligence for teaching and learning in schools: The need for pedagogical intelligence. *Computers & Education*, 217, 105071.

10. Dönmez, E. (2024). The future of education: AI-supported reforms in the USA and China. In *Global agendas and education reforms: A comparative study* (pp. 135-150). Springer Nature Singapore Singapore.
11. Elton, L., & Laurillard, D. M. (1979). Trends in research on student learning. *Studies in higher education*, 4(1), 87-102.
12. Fry, H., Ketteridge, S., & Marshall, S. (2008). Understanding student learning. In *A handbook for teaching and learning in higher education* (pp. 26-44). Routledge.
13. Gocen, A., & Aydemir, F. (2020). Artificial intelligence in education and schools. *Research on Education and Media*, 12(1), 13-21.
14. Guarino, N., Hitzler, P., Kok, J. N., Liu, J., de Mántaras, R. L., Mizoguchi, R., Musen, M., Pal, S. K., & Zhong, N. (2024). Frontiers in Artificial Intelligence and Applications. Proceedings of the 5th International Conference (MMBD 2024),
15. Gudonienė, D., Kubiliūnas, R., Jakštienė, V., Drasutis, S., Stanevičienė, E., & Čeponis, J. (2026). Sustainable and AI-Based Support in the Module of Educational Support Systems. *Sustainability*, 18(14), 7317.
16. Gulson, K. N., Sellar, S., & Webb, P. T. (2022). *Algorithms of education: How datafication and artificial intelligence shape policy*. U of Minnesota Press.
17. Imran, M., Almusharraf, N., Abdellatif, M. S., & Abbasova, M. Y. (2024). Artificial intelligence in higher education: Enhancing learning systems and transforming educational paradigms.
18. Katsamakas, E., Pavlov, O. V., & Saklad, R. (2024). Artificial intelligence and the transformation of higher education institutions: A systems approach. *Sustainability*, 16(14), 6118.
19. Kaushica, J. (2026). Technology-Integrated Teaching in Higher Education: An Empirical Study on AI-Supported Learning, Digital Tools, and LMS Innovations. *Sri Lankan Journal of Applied Sciences*, 4(2), 36-44.
20. Khosravi, H., Shum, S. B., Chen, G., Conati, C., Tsai, Y.-S., Kay, J., Knight, S., Martinez-Maldonado, R., Sadiq, S., & Gašević, D. (2022). Explainable artificial intelligence in education. *Computers and education: artificial intelligence*, 3, 100074.
21. Knox, J. (2020). Artificial intelligence and education in China. *Learning, Media and Technology*, 45(3), 298-311.
22. Kusmawan, U. (2023). Redefining teacher training: The promise of AI-supported teaching practices. *Journal of Advances in Education and Philosophy*, 7(9), 332-335.
23. Lamer, P., & Arnab, S. (2021). Power to the teachers: An exploratory review on artificial intelligence in education. *Information*, 13(1), 14.
24. Lee, H. S., & Anderson, J. R. (2013). Student learning: What has instruction got to do with it? *Annual review of psychology*, 64(1), 445-469.
25. Leon, C., Lipuma, J., & Oviedo-Torres, X. (2025). Artificial intelligence in STEM education: A transdisciplinary framework for engagement and innovation. *Frontiers in Education*,
26. Liao, C.-Y. (2025). AI-supported reading mentorship. *International journal of artificial intelligence in education*, 35(5), 3233-3269.
27. Lytras, M. D., Serban, A. C., Alkhaldi, A., Aldosemani, T., & Malik, S. (2024). Digital transformation in higher education in times of artificial intelligence: Setting the emerging landscape.
28. Mousa, M. (2025). AI-supported formative assessments: Enhancing student-centered learning and teacher perceptions. *Journal of Pedagogy and Education Science*, 4(02), 127-141.
29. Nikolopoulou, K. (2026). AI-powered student support: a conceptual paper on ethical AI in education. *Frontiers in Education*,

30. Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education: Challenges and opportunities for sustainable development.
31. Pham, S. T., & Sampson, P. M. (2022). The development of artificial intelligence in education: A review in context. *Journal of Computer Assisted Learning*, 38(5), 1408-1421.
32. Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International journal of artificial intelligence in education*, 26(2), 582-599.
33. Strickland, K., Chan, W., Hildreth, D., Gottfried, M. A., & Peters, S. The Geography of Gifted Education: Exploring School and Neighborhood Predictors of Access to Gifted & Talented Programs in New York City.
34. Takona, J. (2024). AI in education: Shaping the future of teaching and learning. *International Journal of Current Educational Studies*, 3(2), 1-25.
35. Talpur, M. R. H., Bangash, A. A., Shah, S. B. A., & Maher, K. M. (2026). Artificial Intelligence in Education: A Human-Centered Architecture for Personalization, Assessment, and Responsible Governance. *The Critical Review of Social Sciences Studies*, 4(1), 3039-3057.
36. Tawfik, E., Ali, S., & Yahia, Y. (2024). Towards Evaluating The AI-Embedded Educational Model for Architecture Students and Its Impact on Their Design Outcomes. *Delta University Scientific Journal*, 7(3), 154-173.
37. Vermunt, J. D., & Vermetten, Y. J. (2004). Patterns in student learning: Relationships between learning strategies, conceptions of learning, and learning orientations. *Educational psychology review*, 16(4), 359-384.
38. Wan, Y., Li, R., Li, W., & Du, H. (2025). Impact pathways of AI-supported instruction on learning behaviors, competence development, and academic achievement in engineering education. *Sustainability*, 17(17), 8059.
39. Wang, J., Shi, Y., Chen, X., Lan, Y., & Liu, S. (2025). Teaching with artificial intelligence in architecture: Embedding technical skills and ethical reflection in a core design studio. *Buildings*, 15(17), 3069.
40. Zhong, R., & Zhao, Y. (2025). Education paradigm shifts in the age of AI: A spatiotemporal analysis of learning. *ECNU Review of Education*, 8(2), 319-342.



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