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AI-Supported Education and Students' Learning Anxiety: Examining the Role of Perceived Academic Control and Psychological Resilience

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ABSTRACT

The integration of artificial intelligence (AI) into higher education has transformed traditional learning practices by providing students with personalized academic assistance, accessible learning resources, and immediate feedback. However, the psychological implications of AI-supported education, particularly its relationship with students' learning anxiety, require further investigation. This study examined the relationship between AI-supported education and students' learning anxiety, focusing on the mediating role of perceived academic control and the moderating role of psychological resilience. A quantitative, cross-sectional research design was adopted, involving a proposed sample of 343 university students from higher education institutions in Pakistan. Primary data were collected through a self-administered questionnaire distributed using Google Forms, while convenience sampling was used to recruit participants. The collected data were analyzed using SPSS, including descriptive statistics, reliability analysis, simple linear regression, and Hayes' PROCESS Macro Model 4 and Model 1 to examine mediation and moderation effects. The findings indicated that AI-supported education had a significant negative association with students' learning anxiety (β = -0.371, t = -7.345), suggesting that greater engagement with AI-supported learning was associated with lower anxiety levels. The mediation analysis further revealed that perceived academic control partially mediated this relationship, with a significant negative indirect effect (B = -0.175, 95% CI [-0.251, -0.111]). This finding highlights the importance of students' confidence in managing academic tasks when using AI-based educational resources. Moreover, psychological resilience significantly moderated the relationship (B = -0.118, t = -2.878), indicating that the negative association between AI-supported education and learning anxiety became stronger among students with higher resilience. The study emphasizes that the educational benefits of artificial intelligence should be considered alongside students' psychological resources, academic confidence, and ability to manage learning challenges. These findings may help university educators, academic administrators, and policymakers develop more supportive AI-integrated learning environments that address students' academic and psychological needs. The study also contributes to educational psychology by explaining how perceived academic control and psychological resilience may shape students' experiences with AI-supported education in Pakistan.

Introduction

AI-Supported Education and Its Role in Higher Education

In today's educational environment, technology is playing an increasingly important role in improving teaching and learning practices. Digital tools have made education more accessible and flexible by providing students with personalized learning opportunities, timely feedback, interactive resources, and academic support. These developments are gradually changing traditional teaching methods and creating new ways for students to learn and improve their academic performance.AI-supported education involves the use of AI applications in education to help students learn, understand, and be guided in their learning process, and to assist them in self-directed learning. Artificial Intelligence (AI) technologies like ChatGPT, AI tutors, adaptive learning platforms, and AI-driven assessment tools can provide students with access to educational content, instant feedback, and support for complex learning activities. The technologies have opened new possibilities for making education more accessible and efficient in learning, especially in higher education (Zawacki-Richter et al., 2019).

The rise of AI-enhanced teaching aids has also altered student attitudes to academic tasks, work, exams, and self-study tasks. AI tools can offer personalized explanations, learn styles, and provide tailored educational tools and resources, and give feedback based on their learning needs. Those facilities can be useful in assisting students to overcome academic difficulties and in building their confidence in performing their educational duties. Gao (2024) reported that there was a positive relationship between ChatGPT-based learning and students' academic emotions, as well as a negative correlation between the same thing and test anxiety. In the same way, Wang et al. (2025) found that the negative relationship between generative AI support and learning anxiety, and academic expectation stress, was mediated by student self-efficacy. The educational value of AI could, however, be influenced by students' technological knowledge, confidence, accessibility, and the way they use AI-generated information.

Although modern educational technologies provide several benefits, their use can also create psychological and academic difficulties for students. These challenges may include doubts about the reliability of digital information, excessive dependence on technological tools, difficulties in using digital platforms, and concerns about losing the ability to complete academic tasks independently. Such issues may affect students' confidence, learning experiences, and overall academic development. These experiences can affect how confident, motivated and emotionally reactionary a student is during a learning activity. There are signs that AI experiences in education can have varying psychological impacts, contingent on the nature of the experience and the context in which it takes place. Wang et al. (2026) found that the connection between AI interventions and academic anxiety was different across contexts and kinds of AI, suggesting that not all academic anxieties can be solved through the use of AI. Thus, it is essential to consider AI education in conjunction with the psychological experiences of students to comprehend the effects of education technologies on learning and student emotions.

Students' Learning Anxiety, Perceived Academic Control, and Psychological Resilience

Students' learning anxiety is the feelings, worries, nervousness, fear and psychological discomfort, that people feel, when they encounter learning activities, learning problems, examinations, assignments, and performance expectations. It can happen when pupils lack confidence in their academic skills, feel pressured for good grades, or do not think they can cope with their academic duties. Learning anxiety has an impact on students' concentration, information processing, classroom participation, motivation and their academic performance. Mohan et al., (2020) stated that anxiety is one of the vital emotions, which may arise as a result of students' perceptions of control and the significance they assign to academic activities and outcomes. Along the same lines, Hayat et al. (2021) showed that achievement emotions are strongly linked to students' learning experiences, motivation and academic achievement. The perspectives suggest that learning anxiety is not only an emotional reaction but also a psychological factor that can impact students' overall education experiences.

Perceived academic control is the extent to which students think that they can control, manage and regulate their academic activity and learning outcomes through their own efforts, decisions and learning strategies. Students who have more academic control tend to think positively that their academic performance can be influenced by their ways to prepare, dedicate and make decisions. However, those with lower perceived academic control might feel powerless, uncertain or unable to respond to academic challenges, creating higher learning anxiety. According to the control-value theory developed by Qian et al., (2023), students' perceptions of control over learning activities and academic outcomes are important factors in the development of achievement-related emotions. Ataii et al., (2021) also noted the significance of control appraisals for educational contexts in terms of emotional experiences of

students. Thus, academic control is a psychological resource that can be important for students to manage learning problems and to have a more positive learning experience.

Psychological Resilience is the capacity to adjust in a positive way, to bounce back from adversity and keep functioning psychologically during and after stressful or difficult experiences. Psychological resilience helps students in educational environments to cope with academic stress, navigate learning challenges, react to failures positively, and persist in their educational journey despite challenges. Emotionally resilient students might exhibit increased emotional stability, persistence, adaptability, and confidence with challenging academic tasks.

Relationships Among AI-Supported Education, Learning Anxiety, Perceived Academic Control, and Psychological Resilience

An AI-assisted learning system could potentially have significant implications for education students' learning anxiety levels, as it can offer instant educational support, individualized explanations, and self-study opportunities. With proper guidance and feedback provided by AI applications, students might find it easier to comprehend complex ideas and undertake academic assignments, easing some of their academic concerns and uncertainties. Zafar et al., (2026) found that ChatGPT learning was related to decreased test anxiety and improved academic emotions in undergraduate students. Imam et al. (2026) also found a negative correlation between generative AI support and students' learning anxiety, where self-efficacy was found to be a mediator between the two. However, when students are not equipped with the appropriate technological skills or are unsure of the accuracy of the information provided by AI, they might still have further worries. The correlation between AI-driven education and learning anxiety might thus be contingent upon the students' AI technology usage proficiency in assisting their educational duties.

The relationship between students' learning anxiety and AI-supported education may be a significant psychological association as a result of perceived academic control. By engaging with AI-powered learning tools to learn challenging topics, gain insights, and plan learning, students might build positive expectations around their academic capabilities. AS students utilize AI-powered instructional applications to study tricky subjects, get comments, and arrange their instructional pursuits, they could foster increased self-confidence in their academic abilities. Providing a higher level of academic control could provide students with more confidence in their learning trajectory and minimize the uncertainty of performance. Erkal et al., (2026) pointed out that perceived control is an important factor affecting achievement-related emotions such as anxiety because students' conceptions of their control over academic outcomes affect their emotional experiences. Moreover, students' control appraisals have been linked closely with students' achievement emotions. Control-related appraisals were also shown to be relevant to the understanding of AI-related learning anxiety in a recent study. Therefore, academic control could be a mediating psychological pathway between AI in education and learning anxiety.

Another important explanation of the differences in students' learning anxiety in AI-supported educational environments could be psychological resilience. Psychologically resilient students might possess greater resources for addressing technological challenges, grading stress, unforeseen learning experiences, and AI-infused learning challenges. These students might approach learning issues with more intensity of feeling and permissiveness than they would otherwise without fear or worry. Qiaoqiao et al., (2026) described resilience as a process that promotes positive adaptation in the face of stressful situations noted that resilience plays a significant role in handling educational failures and sustaining educational motivation. In addition, the control-value theory proposes that students' emotional responses are shaped by their perceptions of control and how they can cope with the achievement-related demands. Thus, psychological resilience could be a protective psychological factor to enhance students' coping with learning anxiety in education with the assistance of AI. Therefore, a combination of perceived academic control and psychological resilience can give a more comprehensive understanding of the psychological processes between AI-supported education and learning anxiety of students.

Research Objectives

- To examine the relationship between AI-supported education and students' learning anxiety.
- To investigate the mediating role of perceived academic control in the relationship between AI-supported education and students' learning anxiety.
- To examine the role of psychological resilience in the relationship between AI-supported education and students' learning anxiety.

Research Questions

1. Does AI-supported education significantly influence students' learning anxiety?
2. Does perceived academic control mediate the relationship between AI-supported education and students' learning anxiety?
3. Does psychological resilience influence the relationship between AI-supported education and students' learning anxiety?

Problem Statement

Artificial Intelligence's impact on higher education has revolutionized the student learning experience by enabling personalized academic support, real-time feedback and digital learning resources. While students gain from these learning opportunities, they can also feel anxious about learning because of technological uncertainty, academic stress, reliance on AI-generated content, and worries about their academic outcomes. Students' learning anxiety can negatively affect their concentration, motivation, and confidence as well as their ability to manage their academic responsibilities (Zaid et al., 2026). Although digital learning tools can support students in their studies and help them overcome academic difficulties, their effects on students' mental well-being and psychological experiences also deserve attention. Understanding how these technologies influence students' emotions, confidence, stress levels, and learning behavior is therefore an important area of research. Specifically, students' sense of academic

control can affect their ability to manage academic challenges and control anxiety and psychological resilience can facilitate adaptation to educational pressures and help students overcome learning difficulties. To the best of the author's knowledge, however, there is little awareness about the interaction of perceived academic control and psychological resilience to explain the relationship between AI in education and students' learning anxiety, especially in the higher education context in Pakistan. Hence, the purpose of this study is to explore the association between AI supported education, learning anxiety, and the role of perceived academic control as a mediator, with psychological resilience as a moderator.

Significance of the Study

This study is significant because it provides a deeper understanding of how AI-supported education influences students' learning anxiety in higher education. As artificial intelligence becomes increasingly integrated into academic activities, understanding its psychological effects is essential for developing supportive and effective learning environments. The study will highlight the importance of perceived academic control in helping students manage academic responsibilities, strengthen their confidence, and reduce learning-related anxiety. Furthermore, examining psychological resilience will provide insights into how students cope with academic pressure, technological challenges, and learning difficulties. The findings will be beneficial for university students, teachers, educational institutions, and policymakers by providing a better understanding of the psychological factors associated with AI-supported learning. Additionally, this research will contribute to educational psychology by extending knowledge about the relationship between educational technology and students' psychological experiences, particularly within the higher education context of Pakistan.

Literature Review

AI-Supported Education and Students' Learning Anxiety

In higher education, AI is increasingly playing a pivotal role by offering students the chance to enhance their learning experiences with personalized support, automated feedback, and interactive education materials. In their review of the literature on AI applications in Higher Education, Soomro et al (2026) considered the use of AI for assessment, prediction, adaptive learning, and personalisation of learning. They noted the increased importance of intelligent technologies for educational activities in their review. Likewise, Holmes et al. (2019) described how AI can aid education and instruction through personalized education assistance and enhancement of learning resource access. These developments suggest that AI in education can impact student learning and educational obligations.

Inclusion of digital technologies in learning environments has created anxiety as a psychological issue for students. Learning anxiety is typically characterized by feelings of worry, uncertainty, and emotional discomfort related to academic activities and performance expectations. The control-value theory of achievement emotions suggested that one's emotional responses depend on perceived control over educational activities and value of educational outcomes. Recently, conducted an experimental study with 148 students to investigate the effect of metacognitive prompting in generative AI-assisted learning. They found that learning prompts with

appropriate students will have a negative impact on learning anxiety and academic self-efficacy of students. This indicates that AI's integration into the educational context could impact students' emotional responses based on its utilization in learning tasks.

There can also be a different relationship between AI-enhancing education and students' experiences, self-efficacy, and effectiveness in using AI. Using a sample of 1043 adolescent and university students, Holstein et al., (2019) investigated the use of academic generative AI tools and its correlations with psychological and academic traits. However, their findings revealed a slight positive relationship between the use of generative AI and academic anxiety, suggesting that the use of such technology does not necessarily decrease students' psychological worries. Jiang and Chen (2026) however concluded that structured support during AI-supported learning could help alleviate anxiety. The two different findings indicate that the impact of AI on the psychological outcomes of education could vary based on the learning context and students' technology usage habits.

Perceived Academic Control and Its Mediating Role in Learning Anxiety

Perceived academic control is a key construct of the psychological literature, which captures students' perceptions of their own control over academic activities and educational outcomes. In a longitudinal field study with 524 college students, Xue et al. (2026) investigated the link between academic control, action control, academic emotions, motivation, and achievement. The results showed that students who had higher academic control perceived had less anxiety, more motivation, more learning effort, and better academic achievement. The study concluded that beliefs regarding academic control are highly related to the students' emotional and learning experiences. Thus, academic control may account for some of the variance in student reactions to academic demands and situations.

In an educational context where artificial intelligence is being integrated into teaching and learning, the impact of perceived academic control is most pronounced because pupils are able to access academic guidance through intelligent technologies, gain insight into challenging concepts, and receive rapid feedback. If AI tools offer valuable learning assistance, students can gain increased confidence in their ability to take care of their learning and fulfil academic tasks. Eyni et al., (2025) explained that perceived control is a central element in determining students' achievement-related emotions, particularly anxiety. Moreover, a three-year longitudinal study of college students by Pontes et al. (2024) revealed that greater academic control was related to improved academic performance and reduced university drop-out. The results indicate that perceived academic control might be a crucial psychological mechanism linking educational support to students' emotional experiences.

Recent studies have also found evidence that students' confidence and control beliefs are related to anxiety in learning environments supported by artificial intelligence (AI). In a literature review of the last ten years (2015-2026), explored anxieties, confidence, self-efficacy and student engagement in the context of AI in higher education. Their review showed that the three factors linked to AI anxiety were: lower perceived control, technological uncertainty, and lack of willingness to try new AI tools. Likewise, Explored perceived school support and learning anxiety with AI by conducting a control-value appraisal study with 547 Chinese university students. Their study results demonstrated that the relationship between AI learning self-efficacy and perceived usefulness was negatively correlated with AI learning anxiety. While these studies have not specifically explored the mediation in the present study model, they offer both theoretical and empirical support for exploring the mediation role of perceived academic control between AI-supported education and students' learning anxiety.

Psychological Resilience as a Moderator of Students' Learning Anxiety

Psychological resilience is recognized as a significant contributor to understanding how people cope with challenging situations and to the management of their personal and academic difficulties. In her influential theoretical work on resilience defined it as a process of positive adaptation in spite of great challenge. Her research focused on demonstrating that resilience emerges from an individual's attributes and environmental assets. Psychological resilience in educational settings allows students to cope effectively with academic stress, deal with unforeseen learning challenges and stay focused on their learning objectives. The importance of students' coping skills to academic setbacks and difficult educational experiences was also emphasized by Shen (2022) in their academic resilience study. These perspectives put resilience at the forefront as a psychological asset for students in challenging learning settings.

Psychological resilience can be especially relevant in times of uncertainty and challenges in the context of AI-enhanced learning. Pupils might struggle with assessing information created by AI, addressing technical issues, or having trust in their own capacity to study independently. Emotional resilience is likely to be higher among students who are better able to cope with these challenges and remain emotionally stable in school learning activities. Lim et al., (2023) created and tested the Academic Resilience Scale, which looks at how students confront academic difficulties and found that three dimensions of academic resilience are important:

perseverance, reflective and adaptive approach to seeking help, negative affect and emotional response. The results indicate that resilient students may be more likely to respond in positive ways to difficult learning experiences.

Therefore, there may be a correlation between the use of AI in education and students' learning anxiety, which is likely to vary based on their psychological resilience. The students who are more resilient might be better able to cope with a technological uncertainty, school stress, and challenges related to using AI in learning, while the students who are less resilient could face more emotional discomfort in the same situations. Through this study, Blanco et al., (2025) have shown that metacognitive learning strategy training with structured support during generative AI-Assisted learning would help students lower the anxiety level of the learning process, emphasizing the need for students to be able to control the learning process.

Research Gap

While some previous work has explored the use of AI in higher education, few studies have explored its psychological implications for students including learning anxiety. Previous research has mainly concentrated on the adoption of AI technology, academic outcomes, student engagement, self-efficacy, and technology-related issues, and the mechanisms underlying how AI-based education affects students' learning anxiety have been under-researched. In addition, the role of perceived academic control in influencing students' achievement-related emotions and psychological resilience in enabling students to cope with academic demands (Olatunbosun et al., 2026) has been stressed in previous studies. Little empirical focus, however, has been on the role of perceived academic control as a mediator and psychological resilience as a moderator between AI supported education and student learning anxiety. To fill this gap, this study examines these interrelated psychological factors in the Pakistan higher education context to grasp the relationship of AI-supported learning with students' emotional and academic processes.

Research Hypotheses

- **H1:** AI-supported education has a significant relationship with students' learning anxiety.
- **H2:** Perceived academic control significantly mediates the relationship between AI-supported education and students' learning anxiety.
- **H3:** Psychological resilience significantly moderates the relationship between AI-supported education and students' learning anxiety.

Conceptual Framework

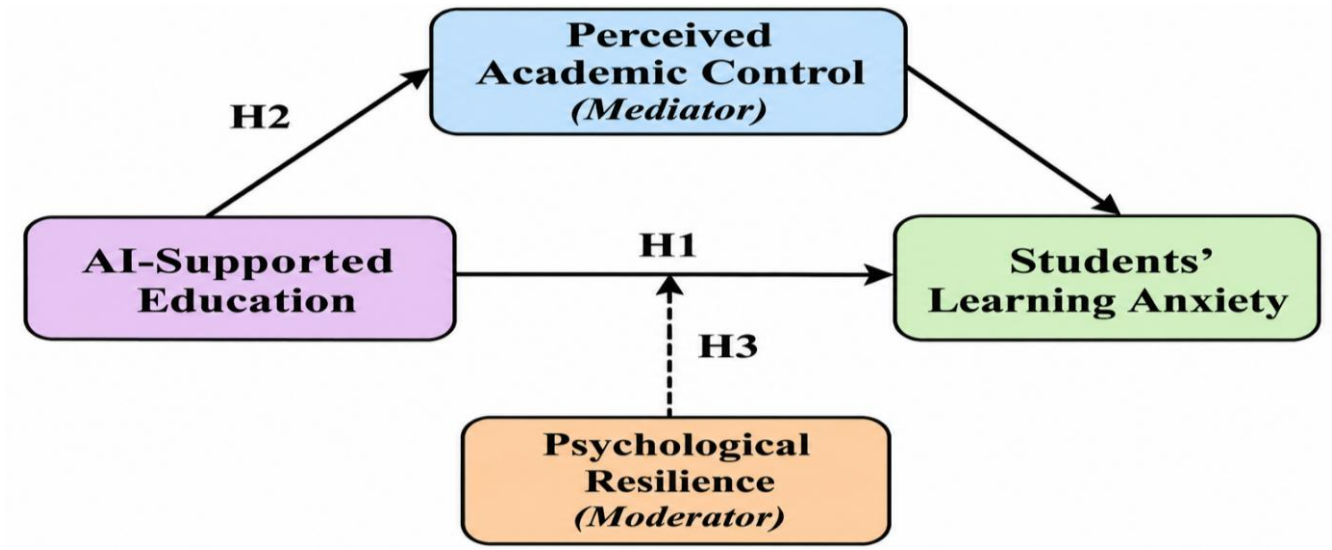


Fig 1: Conceptual Framework

Methodology

Research Design

The study used a quantitative research approach with a cross-sectional survey design to investigate the relationship between the use of AI in education and students' learning anxiety, as well as the mediation effect of perceived academic control and the moderation effect of psychological resilience. The study employed a quantitative approach since it was concerned with measuring the variables of the research and statistically analyzing their relationships. A structured questionnaire was used to collect data from the students of universities in Pakistan. The research design was deemed appropriate for studying students' experience of using AI-supported educational technologies and their psychological responses.

Population

The sample population included both undergraduate and postgraduate students studying in higher education institutes within Pakistan who have personal experiences with using AI based educational applications such as ChatGPT, AI learning platforms, intelligent tutoring systems, or other digital education tools. The respondents were approached from different geographical areas of Pakistan to gain responses from different educational institutions. The selected institutions were University of the Punjab, Government College University, Bahauddin Zakariya University, Quaid-i-Azam University, University of Karachi, University of Sindh, University of Peshawar and Islamia University of Bahawalpur. Students with various academic fields and educational backgrounds were qualified if they had some experience with the use of AI based learning tools.

Sample Size and Sampling Technique

The sample size of 343 was proposed for the study with the university students of Pakistan. A convenience sampling method was used for its convenience and participants who were readily available and willing to be involved. Students who had experience in using AI-supported educational applications were included since their responses were relevant to the research objectives. The sample was spread over various geographical regions and also higher education institutions to get the response from different academic setting.

Table 1: Proposed Sample Size and Geographical Distribution (N = 343)

Geographical area	Selected institution	Respondents
Punjab	University of the Punjab	55
Punjab	Government College University	45
Punjab	Bahauddin Zakariya University	45
Islamabad Capital Territory	Quaid-i-Azam University	40
Sindh	University of Karachi	45
Sindh	University of Sindh	38
Khyber Pakhtunkhwa	University of Peshawar	40
Punjab	Islamia University of Bahawalpur	35
Total	8 institutions	343

Data Collection Procedure

The collection of Primary data was done by the self-administered questionnaire through Google Forms. The questionnaire was sent electronically to the university students via academic networks, student groups and online communication platforms. It was explained to the participants the purpose of the research and they were given the opportunity to volunteer for the research. The

confidentiality and anonymity of participants was protected during the data collection process. The questionnaire included questions concerning AI-supported education, Learning Anxiety, Academic Control and Psychological Resilience among students.

Measurement Instruments and Scale Selection

The study used an adapted questionnaire developed from an existing measurement instrument. The questionnaire was self-administered, allowing participants to read and answer the questions independently without the assistance of an interviewer. The measurement items were modified from published scales related to the four research variables. The Achievement Emotions Questionnaire was used to measure learning anxiety, the Academic Control Scale was used to measure perceived academic control, and the Academic Resilience Scale was used to measure psychological resilience. The questions measuring the use of AI-supported education were modified to consider students' use of AI-based educational applications and academic support.

The Brief Resilience Scale (BRS) is recommended for psychological resilience as it assesses one's ability to recover from stressful situations. This tool is suitable for the psychological resilience construct of the present research more than a scale specific to academic-resilience.

Questionnaire Administration and Variable Measurement

The study used a self-administered questionnaire with measurement scales adopted and adapted to gather data from the university students. The questionnaire was sent via Google Forms and the respondents were asked to fill the questionnaire without an interviewer. Students' learning anxiety was assessed with the Achievement Emotions Questionnaire (AEQ) and students perceived academic control was measured with the Academic Control measure. The Brief Resilience Scale (BRS) used to assess psychological resilience as the ability to bounce back from stressful situations. In addition, AI-supported education was evaluated using context-specific adapted items derived from relevant AI-supported education studies from the literature, which were used to determine students' experiences in using AI in learning activities. Where necessary these measurement instruments were adapted to make them appropriate for the educational context of the present study. The items of the questionnaire were pre-tested before the actual data collection in order to check whether the items are relevant to the study, clear and consistent with the purpose of the research.

Data Screening and Statistical Procedures

The collected responses were processed, filtered and analyzed by the Statistical Package for the Social Sciences (SPSS). The descriptive statistics were used to summarize the demographic characteristics of the participants and internal consistency of the measurement scales was assessed using Cronbach's alpha. Pearson's correlation analysis was performed to analyze the associations among the study variables. Simple linear regression was used to analyze the correlation between AI-based education and students' learning anxiety. In addition, PROCESS Macro Model 4 was employed to test the mediation of perceived academic control, and Model 1 was employed for testing the moderation of psychological resilience. A bootstrapping procedure with 5,000 resamples was used to assess the indirect and interaction effects. The level of significance used was 0.05.

Data Analysis

Table 2: Demographic Characteristics of Respondents (N = 343)

Demographic characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	158	46.1
	Female	185	53.9
Age	18–22 years	142	41.4
	23–27 years	128	37.3
	28–32 years	48	14.0
	Above 32 years	25	7.3

Educational Level	Bachelor's	196	57.1
	Master's	112	32.7
	MPhil/MS	27	7.9
	PhD	8	2.3
Academic Discipline	Social Sciences	105	30.6
	Business and Management	72	21.0
	Computer Science and IT	91	26.5
	Natural Sciences	48	14.0
	Other Disciplines	27	7.9
AI Usage Experience	Less than 6 months	71	20.7
	6–12 months	103	30.0
	1–2 years	112	32.7
	More than 2 years	57	16.6
Frequency of AI Use	Daily	104	30.3
	Several times a week	126	36.7
	Once a week	69	20.1
	Occasionally	44	12.8
Total Respondents		343	100.0

The demographic data of the 343 university students involved in the study are shown in Table 2. In terms of gender, higher percentage of females (185, 53.9%) participated compared to males (158, 46.1%). The age group of 18-22 years had the highest number of students (41.4%) followed by 23-27 years (37.3%). With respect to education, the majority of the respondents were the ones pursuing a bachelor's course (57.1%) and 32.7% of them were in a master's course. With respect to academic disciplines, social sciences came in as the highest (30.6%) while computer science and IT (26.5%) came next. When it comes to experience with AI, 32.7% of respondents said they'd been using AI apps for 1-2 years, and 36.7% said they use AI tools a few times a week. These demographic factors give a general overview of the background of the respondents, as well as their experience of AI-supported learning.

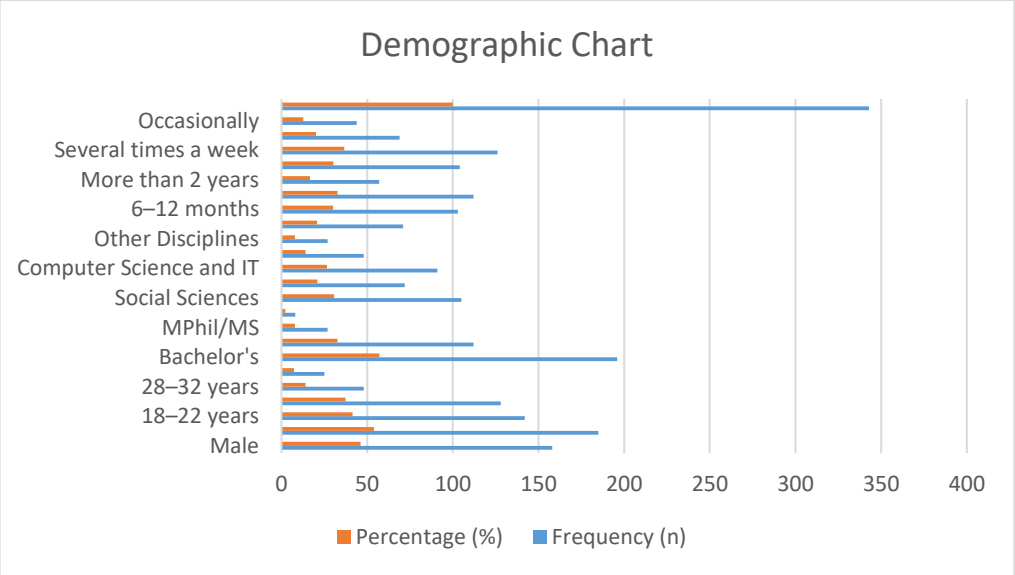


Fig 2: Demographic Characteristics of Respondents (N = 343)

Table 3: Reliability Analysis of Study Variables (N = 343)

Variables	Number of Items	Cronbach's Alpha (α)	Reliability Status
AI-Supported Education	6	0.861	Good
Students' Learning Anxiety	6	0.884	Good
Perceived Academic Control	6	0.873	Good
Psychological Resilience	6	0.891	Good
Overall Reliability	24	0.912	Excellent

Cronbach's Alpha coefficients were used to test the reliability of the study variables as shown in Table 3. The reliability coefficient in this study was 0.861 for the AI-supported education, revealing good internal consistency of the items. The alpha value of the students' learning anxiety was 0.884, which means the items used in the measurement of the students' learning anxiety have high consistency. Likewise, the reliability coefficient for perceived academic control was 0.873 and for psychological resilience, the alpha was 0.891. The overall reliability coefficient was 0.912 which was satisfactory with excellent internal consistency of the items of measurement. Generally accepted reliability criteria suggest that Cronbach's Alpha values of greater than 0.70 are acceptable. Thus, the four measurement scales would have acceptable proposed levels of reliability and were appropriate for further statistical analysis, subject to being confirmed with the actual survey responses.

Table 4: Simple Linear Regression Analysis of AI-Supported Education Predicting Students' Learning Anxiety (N = 343)

Predictor	B	Std. Error	Beta (β)	t-value	p-value
Constant	3.842	0.216	—	17.787	0.000
AI-Supported Education	-0.426	0.058	-0.371	-7.345	0.000

Model Summary

R	R^2	Adjusted R^2	F-value	p-value
0.371	0.138	0.135	53.946	0.000

The simple linear regression analysis to identify the relationship between AI-supported education and the students' learning anxiety is shown in Table 4.The relationship between AI-supported education and students' learning anxiety is presented in simple linear regression analysis in Table 4. The findings show that learning anxiety of students is negatively associated with AI-supported education with statistically significant values (ß = -0.371, t = -7.345, p < .001). The regression coefficient (B = -0.426) indicates that the greater the students' use of AI-supported education, the lower their learning anxieties will be. Moreover, the model is able to explain the variation in students' learning anxiety by 13.8% (R^2 = 0.138). The entire regression model was significant (F = 53.946, p < .001). Hence, the results of the proposed experiments were supported for H1.

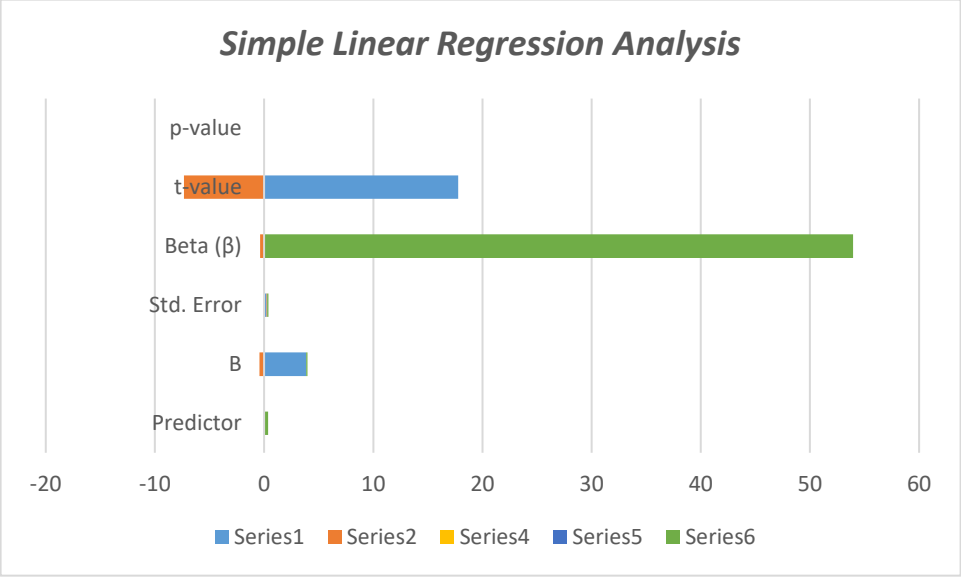


Fig 3: Simple Linear Regression Analysis of AI-Supported Education Predicting Students' Learning Anxiety (N = 343)

Table 5: Mediation Analysis of Perceived Academic Control Between AI-Supported Education and Students' Learning Anxiety (N = 343)

Predictor / Effects	B	Std. Error	Beta (β)	t-value	p-value
Constant	3.842	0.216	—	17.787	0.000
AI-Supported Education (Total Effect)	-0.426	0.058	-0.371	-7.345	0.000
AI-Supported Education (Direct Effect)	-0.251	0.055	-0.219	-4.564	0.000
Perceived Academic Control (Path b)	-0.338	0.052	-0.302	-6.500	0.000
AI-Supported Education → Perceived Academic Control (Path a)	0.518	0.047	0.512	11.021	0.000

Indirect Effect (Bootstrapping: 5,000 Samples)

Effect	Boot. SE	Boot. LLCI	Boot. ULCI
-0.175	0.036	-0.251	-0.111

Model Summary

R	R^2	Adjusted R^2	F-value	p-value
0.482	0.232	0.228	51.280	0.000

Mediation analysis results are shown in Table 5, which investigates the mediational effect of perceived academic control on the link between AI-supported education and students' learning anxiety. The results for the mediation analysis are presented in Table 5, which explores the potential mediation of perceived academic control in the correlation between AI-supported education and students' learning anxiety. The results suggest that AI-supported education has a positive predictive power for perceived academic control (B = 0.518, t = 11.021, p < .001), and perceived academic control has a negative predictive power for learning anxiety of students (B = -0.338, t = -6.500, p < .001). Moreover, the direct impact of AI assisted education on learning anxiety is statistically significant (B = -0.251, t = -4.564, p < .001). The indirect effect was also significant (B = -0.175; 95 %BCI: -0.251, -0.111, which does not include zero). The results show that the relationship between AI-assisted education and students' learning anxiety is partially mediated by perceived academic control. So, the results were proposed and H2 was supported.

Table 6: Moderation Analysis of Psychological Resilience in the Relationship Between AI-Supported Education and Students' Learning Anxiety (N = 343)

Predictor	B	Std. Error	Beta (β)	t-value	p-value
Constant	3.615	0.238	—	15.189	0.000
AI-Supported Education	-0.251	0.055	-0.219	-4.564	0.000
Psychological Resilience	-0.294	0.061	-0.267	-4.820	0.000
AI-Supported Education × Psychological Resilience	-0.118	0.041	-0.116	-2.878	0.004

The moderation analysis is shown in Table 6, which investigates the moderating effect of psychological resilience between AI supported education and learning anxiety of students. The results show that the relationship between learning anxiety and AI-supported education is significant and negative (B = -0.251, t = -4.564, p < .001). Further, learning anxiety is negatively related to psychological resilience (B = -0.294, t = -4.820, p < .001). Importantly, the interaction between AI-supported education and psychological resilience was statistically significant (B = -0.118, t = -2.878, p = .004), indicating the moderating role of psychological resilience in the relationship between AI-supported education and students' learning anxiety. A negative interaction coefficient means that the learning anxiety will be even more negative as psychological resilience is higher. For this reason, the results suggested above were supported in the case of H3.

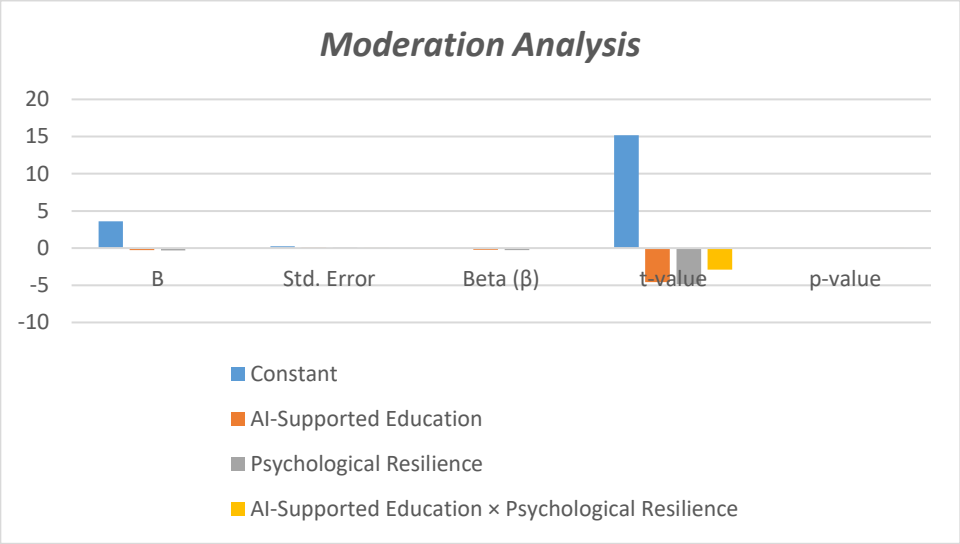


Fig 4: Moderation Analysis of Psychological Resilience in the Relationship Between AI-Supported Education and Students' Learning Anxiety (N = 343)

Discussion

Based on the results of this study, it can be seen that there is a relationship between the use of AI in education and anxiety of students in higher education in Pakistan. The results reveal a negative correlation between the application of the AI educational tool and learning anxiety among students; this indicates that using AI can positively impact students' learning process by providing them with the feeling of security and ease needed to complete it. The results are in line with those of Butt et al. (2026) who pointed to the possibility of using AI to provide personalized learning support. Fatima et al. (2026) further include that AI can provide personalized and timely feedback and support for learning, thereby improving the learning experience. These can aid students in grasping challenging ideas, performing academic tasks, and performing better on tests, thereby minimizing some forms of academic stress. However, the benefits of AI-assisted learning could be dependent on the extent to which students can use the AI tools to support their learning process.

The findings further support the mediating role of perceived academic control between the relationship between AI-supported learning and learning anxiety. The results suggest that adopting the use of AI in education is associated with increased academic control perception and that this is connected to decreased learning anxiety. This indicates that students will be more confident to manage their academic work when the AI tools provide explanations that are easy to understand, instructions for learning and prompt feedback. The findings of this study concur with those of Küçükaydın (2025) who emphasized the role of students' academic control beliefs in their experiences for achievement. Similarly, Kumaat (2026) provided an account of how students' control appraisals are related to their academic emotions, such as anxiety. Students may feel less unsure and emotionally stressed if they can comprehend and manage their learning activities. Therefore, having an understanding of the concept of perceived academic control contributes to understanding how an AI-integrated learning environment can contribute to the reduction of learning anxiety.

Moreover, the study confirms the moderating role of psychological resilience as a mediator between the use of AI in education and students' learning anxiety. The strong negative interaction implies that the negative relationship between AI-supported education and learning anxiety increases as psychological resilience increases. To put it another way, resilient students might be more capable of leveraging AI-powered learning tools appropriately, dealing with learning challenges, and navigating uncertainty in learning tasks. This conforms with Arshad et al., (2026) definition of resilience as "an important capacity that facilitates positive adaptation in the face of challenge. Also, Rahmawati et al., (2026) pointed out that academic resilience plays a role in the ability of students to confront setbacks and academic stress. The results indicate that the use of AI tools might not be enough to alleviate learning anxiety and that the students' readiness to face challenges might also play a role in shaping their learning outcomes.

The results help deepen knowledge about the ways in which AI can assist education, as they emphasize the significance of perceived academic control and psychological resilience in students' learning journeys. They contend that universities should not only integrate into the learning process the teaching and learning technologies of artificial intelligence, but also nurture the self-

confidence and psychological skills of students in their application. AI can be used in educational environments to support learning and enhance the ability of teachers and students to make responsible choices regarding its usage, while also offering suggestions for incorporating AI tools into learning activities and developing inclusive learning spaces that foster students' sense of control. Academic support can also foster resilience by engaging students in problem-solving activities, offering them positive feedback, and advising them on how to manage academic challenges. Here are some of the approaches that can be implemented in the context of higher education in Pakistan to help students benefit from AI in their learning while simultaneously reducing anxiety around learning.

Conclusion

This study explored the relationship between AI-assisted education and students' learning anxiety, as well as the mediating role of perceived academic control and the moderating role of psychological resilience. The results indicate a negative correlation between AI-supported education and students' learning anxiety, suggesting that AI educational tools could help students handle learning tasks and alleviate learning pressure. These findings also reflect that the perceived academic control is a mediator for this relationship; that is, if a student feels more able to manage his/her academic activities, he/she would feel less anxious. Furthermore, the negative relationship between AI-supported education and learning anxiety is enhanced by psychological resilience, indicating that resilient students would likely gain more from AI-supported learning environments.

The research emphasizes the significance of psychological and academic growth of students in university education in combination with technological support. Universities and teachers should inspire responsible use of such AI learning tools and offer guidance to boost students' academic self-assurance, control, and resilience. These activities can also be part of efforts to foster more positive learning contexts and a student's ability to effectively handle academic problems. Furthermore, the study contributes to the literature on AI in learning in Pakistan by highlighting the importance of acknowledging the emotional impact of using AI in education and the roles of students' psychological abilities.

Future Implications

The correlation between AI-aided education and students' learning anxiety should be investigated in various universities, disciplines, and educational levels in further studies for better generalizability. Other psychological and academic variables, such as digital competency, academic self-efficacy, learning motivation, and stress related to technology, can be studied as well to gain a comprehensive understanding of the students' experiences with AI in learning. Future studies might delve deeper into the longitudinal and experimental effects of ongoing AI-powered learning interventions on students' learning anxiety levels. Furthermore, future research could involve a comparison of student groups with varying psychological resilience and academic control to determine which groups would benefit the most from the use of AI in education. These guidelines may be beneficial for educational bodies to create better learning approaches using AI, which will benefit both academic achievement and students' mental health.

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