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AI-Supported Education and Academic Performance under Stress: The Moderating Role of Coping Self-Efficacy among University Students

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ABSTRACT

The present study investigated the role of AI-supported education in students' academic performance, with particular attention to academic stress and the moderating role of coping self-efficacy. Using a quantitative cross-sectional design, data were collected from 397 university students in Punjab and Sindh, Pakistan, through a structured online questionnaire. The findings indicated that AI-supported education was positively associated with academic performance, suggesting that AI-based learning resources can enhance students' educational outcomes by facilitating learning, improving access to academic support, and encouraging greater engagement with educational activities. In contrast, academic stress was negatively associated with academic performance, indicating that excessive academic demands may hinder students' achievement and reduce their ability to benefit fully from available learning resources. Students with higher coping self-efficacy also demonstrated better academic performance, highlighting the importance of confidence in managing academic challenges and stressful academic demands. Moreover, coping self-efficacy significantly strengthened the positive relationship between AI-supported education and academic performance, suggesting that students with stronger coping abilities may benefit more effectively from AI-based learning resources. These findings indicate that the effectiveness of AI-supported education may depend not only on students' access to technological resources but also on their psychological capacity to manage academic challenges. The study therefore emphasizes the importance of developing students' coping abilities alongside technological competencies to maximize the educational benefits of AI. The study highlights the importance of integrating AI literacy and responsible technology use with academic guidance, stress-management strategies, and psychological support to promote academic success.

Introduction

Artificial Intelligence (AI) has become an important part of higher education. It helps students find information more easily, understand concepts better, complete their assignments, and receive feedback on their work. Today, many AI tools such as ChatGPT, AI tutors, adaptive learning platforms, automated feedback systems, and virtual assistants are being used to support students in their learning process. They are designed to provide individualized, instant support for learning. These tools can

support learning by utilizing scaffolding for each step in the learning process such as locating information, problem solving, and case study learning objectives and self-directed learning. Overall, they can increase student engagement and attainment. However, the main drivers for AI in education remain the extent to which students choose to use these tools in their learning (Aslam et al., 2026; Iqbal et al., 2025).

However, higher education students face numerous academic and psychological pressures caused by the demands of study, exams, assignments, deadlines, competition and other academic pressures. Many studies have shown that increased academic pressure and stress has a negative impact on concentration, motivation, thinking and studying. Stress has been shown to negatively affect academic results with studies from Pakistan showing that there is a direct and negative relationship between stress and academic results (Küçükaydın, 2025; Usman et al., 2025). When attempting to analyze student results, we need to consider both the tools and resources designed for learning, and the psychology of the student within that learning environment.

Coping self-efficacy helps students in the higher education system develop the ability to adapt to challenges caused by the introduction of AI-based educational tools and the environment in higher learning. With the ability to cope, goal directed learning and academic motivation and concentration can be sustained in the face of intense, negative, emotional states.

Self-efficacy and the control of stress both impact engagement at the academic level. The impact of stress and self-efficacy has been documented JOGHEE et al. (2025). This study aims to analyze the potential impacts of AI in the field of learning with respect to the impact on a student's academic performance. The study examines if the domain of coping self-efficacy is dominant when students experience academic stress and if the use of AI in learning is then affecting or impacting academic performance. The study aims to merge technology and psychology to a larger extent in the relatively unstudied area of academic performance for AI assisted learning frameworks in Higher Education.

AI-Supported Education

AI-Enabled education uses artificial intelligence (AI) tools to support teaching and learning activities such as offering academic support services, learning materials, assessments, feedback, and customized solutions to learning challenges. These machines can provide learner support by explaining and giving examples, including writing support. Examples of these tools at the tertiary level include automated feedback systems, AI assistants, intelligent tutoring systems, adaptive learning systems, and text generators (i.e., ChatGPT). Consistent with the expectations, these systems can provide students with immediate feedback, examples, and explanations. This increases students' ability to learn and improve their academic performance. This is supported by recent findings in Pakistan with KHAN et al. (2025) reporting that the use of ChatGPT as a learning resource improved the academic performance of students at the tertiary level. In the same vein, Aslam et al. (2026) reported that AI tools used at universities, such as ChatGPT, increased learning and engagement opportunities with a focus on accessibility and personalization.

Although AI offers powerful tools in educational franchising, it is important to recognize its potential dangers. For example, the benefits that students would retrieve from educational franchising through AI tools may not be useful if there is a loss of understanding of the content or if AI tools may introduce false information. Students may even end up losing their ability to think critically. In this regard, recent research has focused on the restrictions to the use of AI tools in educational franchising support, which is aimed at students' active learning (Dönmez, 2024).

Research indicates that these phenomena are also applicable to university students in Pakistan. These students highlighted the Tutorial Scaffolding and learning flexibility elements of ChatGPT, and expressed some concerns regarding educational ethics (Borges et al., 2026).

In this study, we consider AI-based education as the purposeful application of AI-based technologies to assist users in completing academic tasks, to process information and resources, and to solve problems and comprehend concepts. This would be contextualized by the psychological state of users. Students with high levels of academic stress would be unable to concentrate and organize their learning. They would be unable to assess/evaluate information or exert enough effort to complete tasks. Other students of high academic self-efficacy would be able to control learning, manage stress and attend to the available tools and positively transform them. In the context of high academic stress and self-efficacy, we would be able to study the impact of AI-based education on the improvement of students studying at higher levels of education (Selamet, 2026).

Academic Performance

Academic performance describes a student's achievement of instructional outcomes and is usually assessed by indicators like grade point average, exam scores, course grades, how well a student completes assignments, achievement/ success scores, etc. Apart from assessment tools and indicators, academic performance evidences and reflects students' cognitive engagement as well as their motivation, persistence, and the overall ability to meet the expectations of the higher education system. For this reason, academic performance is a primary outcome of (Păduraru et al., 2025; Popa-Velea et al., 2021) higher education. It enables assessing the effectiveness of educational practices and resources of the higher education system and the academic behavior of students.

Academic performance depends on both educational and personal factors. Students can achieve good results when they are motivated, believe in their abilities, stay strong during challenges, manage stress effectively, and use suitable learning strategies. Positive behavior and self-discipline also play an important role in helping students succeed in their studies. Multiple studies have confirmed the presence of positive relationships of the psychological components of stress and self-efficacy and resilience to academic achievement and performance (Wentzel & Wigfield, 1998). The recent increase in the use of AI-based technology in academia has created additional concerns regarding academic performance since these technologies offer speed and flexibility in information retrieval as well as individualized feedback and explanations, problem-solving scaffolds, and other supports.

Many studies have shown that there are more positive outcomes in academic performance as AI, like ChatGPT and generative AI systems, are safely integrated into higher education classrooms. However, it is important to view AI programs as resources so that their benefits may depend on safe and responsible use, learning behaviors and their psychological traits (Richardson et al., 2012).

The nature of this research warrants looking at how university students may be starting to use AI to help alleviate the stress of academic tasks, while at the same time experiencing the challenges and stress of revising and preparing for academic assessments (Fenollar et al., 2007). AI helps students demonstrate understanding and complete learning tasks; moreover, it is used to obtain learning task feedback and prepare for academic tasks. However, students under high levels of academic stress lack the concentration, emotional control, and behavioral Diligence and persistence to myriad learning activities. By contrast, students with high overall self-coping efficacy resource use are better able to control and adjust to academic stress, while using AI as a supplemental learning resource. In this light, understanding the relationship between AI in education and stress and academic coping self-efficacy resource systems is crucial to understanding the diverse academic self-success strategies students bring to higher education (Mushtaq & Khan, 2012).

Academic Stress

Academic stress occurs when students feel that their studies are too difficult to manage. It can result from frequent exams, a heavy workload, tight deadlines, pressure to achieve high grades, and competition with classmates. When these demands become overwhelming, students may experience stress and anxiety related to their academic responsibilities. University students can experience stress from multiple factors outside of academia, including personal, social, and financial commitments and concerns about the establishment of their careers. Several studies have identified time pressure, intense workload, and high load examinations as some of the key stressors and have established a clear relationship between perceived academic stress and distress as well as academic functioning (Zhao & Zhang, 2024).

High levels of academic stress can impact a student’s ability to learn. This can be caused by distractions, an increase in the difficulty of the task, decreased motivation, and inability to engage in learning activities. Studies have established a clear causal relationship between stress and decreased academic performance. In their study, Javaid et al. (2024) observed a negative correlation between perceived stress and academic performance among students of the first year of public universities in the Punjab region of Pakistan. Similar studies in Pakistan have focused on the relationship between academic stress and academic performance. In addition, their findings have verified the role of academic stress in the broader context of higher education across nations.

According to recent research, academic stress can negatively affect students’ academic performance. However, self-efficacy plays an important role in helping students cope with academic challenges. Studies have shown that students who experience high levels of stress and have low confidence in their abilities are more likely to perform poorly in their studies. In contrast, students with strong self-efficacy are better able to manage academic pressures and achieve better learning outcomes (Agolla & Ongori, 2009). The importance of academic stress in this study stems from the dual burden of academic pressure and the use of AI in

educational technologies. With the use of AI in education, certain academic burdens may be eased because AI can provide answers, feedback, and other learning aids in a matter of seconds. Technology may also address the academic stress; however, it is unlikely that the pressure of academic work will not leave a psychological burden. For example, some students will have high levels of academic stress, while others will have poor concentration, emotional instability, and low motivation to use the AI technologies. On the other hand, some students will have a high level of coping self-efficacy, which allows them to reduce the burden of academics and utilize the resources of AI in education. This viewpoint is justified by stress and self-efficacy being closely intertwined, and longitudinally by the presence of self-efficacy and perceived stress, which influences one another. Because perceived stress is an important influencer of academic performance, this study examines coping self-efficacy, psychologically, as a resource that improves the benefits of AI in education while under tremendous levels of academic stress (Kumaraswamy, 2013).

Coping Self-Efficacy

Coping self-efficacy is a person's confidence in their ability to handle difficult situations and challenges. It involves believing that they can manage stress, adapt to changing circumstances, and use effective strategies to deal with problems. People with high coping self-efficacy are generally better able to face challenges and recover from stressful experiences. This construct is distinct from general self-efficacy, as the latter involves people's coping skills in dealing with adverse and stressful conditions. In educational settings, this construct may be relevant in the ways students understand the demand of the tasks, regulate emotions, maintain persistence, and use effective strategies in dealing with the demands of exams, the urgency of tasks, and the expectations of performance (Chesney et al., 2006). Individuals who are high in coping self-efficacy interpret the demands of tasks as challenge and kind of obstacle that they can manage and respond using instrumental behavior to the demands of the situation. Recent studies have shown that self-efficacy is one of the most important psychological factors in an educational setting. Higher self-efficacy leads to better performance at school and fewer adverse effects of stress and pressures of school work. One of the unpublished studies by (Freire et al., 2020) states that students with higher self-efficacy were able to perform better despite the presence of academic stress.

Coping self-efficacy is even more important when dealing with AI powered education. Self-regulation of one's learning and effective coping will remain important despite the many tools available to the student. Students will still need to decide when to engage the AI to help them, ask thoughtful questions, and integrate AI outputs into their learning work (Lane et al., 2002).

Students with higher coping self-efficacy should be able to maintain behaviors that are flexible and adaptable to changes in academic demand, whereas students with lower coping self-efficacy may not be able to deal with the stress of academia and sustain their effort. Recent data suggests psychological stress adversely impacts academic work and performance with increased cognitive demands and a decrease in self-efficacy, which adds to the importance of psychological resources in the realm of academics. Similar research from Pakistan describes that there is a connection between the strategies to cope with stress and the stress brought about by academics on university students. It also describes the need for students to respond to difficult, challenging situations in academics. Recent Pakistani research studying the implications of ChatGPT on self-efficacy also describes that there is a connection between self-efficacy and student involvement, adding to the psychological implications of AI-supported learning (Delahaij & Van Dam, 2017).

For the current study, the authors describe how coping self-efficacy is a valuable psychological resource that enhances the connection of AI-based education with academic performance. Students with higher levels of coping self-efficacy may be able to use AI productively as a learning resource while dealing with the academic demands, regulating emotions, and maintaining motivation towards challenging tasks in academics. There is also emerging evidence that may validate the authors' perspective (Cieslak et al., 2008). One of the recent studies that was conducted with university students from Punjab and Sindh, Pakistan examined AI in the context of student anxiety, academic engagement, and coping self-efficacy, describing that coping self-efficacy significantly moderated the relationship between anxiety and academic engagement.

While this study investigated anxiety and engagement rather than academic stress and performance, its findings provide useful evidence that coping self-efficacy alters how psychological symptoms are transformed into educational outputs in AI-supported settings. Consequently, this study aims to fill this gap in the literature by examining whether coping self-efficacy changes the AI-supported education and stress performance nexus, in the context of performance under stressful academic circumstances. It is acknowledged that in the context of AI-supported education, students may be presented with resources that may assist with academic performance, but whether those resources are optimally utilized may be contingent upon the psychological component of coping with academic demands (Nicholls et al., 2010).

Moderating Role of Coping Self-Efficacy

This study proposes that coping self-efficacy may moderate the relationship between AI-supported education and academic performance based on students' academic stress management. Moderation occurs if the strength or direction of a predictor-outcome relationship is contingent on a third variable. In this study, AI-supported education is the predictor, academic performance is the outcome, and coping self-efficacy is the moderating variable in a stressful academic environment. This framework assumes that the use of AI-based educational elements may not bring the same advantages to all students. It is based on the different psychological capacities of the students in stress management. Some research shows that self-efficacy is an important factor in better academic performance and in reducing the effect of academic stress (Liu et al., 2024; Peltier et al., 2022). For this reason, coping self-efficacy can be an important psychological resource in studying how students respond to using AI-based learning technologies.

Students with high levels of coping self-efficacy may be more skilled in using AI supported educational resources when demands in academic tasks rise. They may use AI to explain difficult concepts, organize their tasks, find gaps in their learning, obtain feedback, and support problem solving while leaving the learning process under their control. Their confidence in stressful situations may enable them to continue to focus and be motivated, thus converting the AI assistance into functional academic behavior (Chirico et al., 2017).

High levels of stress may affect students' ability to take advantage of various technologies in a constructive way. Students may have difficulty determining learning goals, assessing the quality of information generated by AI, staying persistent, and most importantly, incorporating the technologies as part of functional and effective study practices. There is a concern that students with fewer coping resources may utilize the technologies to avoid performing more demanding academic tasks and, consequently, use AI to substitute learning (Mahoney et al., 2023). Thus, self-efficacy related to coping may be an important factor in determining the role that AI-based technologies may have on learning outcomes.

There is some new evidence to justify studying this moderating factor. Latest studies done with students from Punjab and Sindh, Pakistan, exploring AI-based learning, anxiety, academic engagement and coping self-efficacy revealed that coping self-efficacy moderated the relationship between anxiety and academic engagement. This shows that some psychological resources may be used to cope with different psychological issues, while others may modulate the transformation of these issues into educational concerns. Although this study dealt with anxiety and engagement rather than academic stress and academic performance, it may be suggested that this moderation framework may be extended to other concepts. Considering that academic stress may have a negative impact on academic performance and that self-efficacy may have a positive impact on academic performance (Prati & Pietrantoni, 2016), this study suggests that the use of AI-based technologies for learning may be positively impacted by coping self-efficacy (Karakuş & Göncü-Köse, 2023).

Research Objectives

- To examine the relationship between AI-supported education and academic performance among university students.
- To assess the relationship between academic stress and academic performance among university students.
- To determine the moderating role of coping self-efficacy in the relationship between AI-supported education and academic performance under stress among university students.

Problem Statement

The use of AI in education allows more modified instruction and accommodates learners at different stages. However, there is great variability in the extent to which this technology may help learners based on their psychological and academic profiles. Research focusing on adoption and use of AI in education has mainly addressed its direct impact on educational attainment. Relatively speaking, little research has addressed the psychological factors that may help us understand the adoption, use, and engagement with AI, and its impact on educational attainment. While academic stress will always be a concern in higher education, especially because of its connection with educational attainment, Pakistani studies have demonstrated mixed findings in different contexts. Although academic stress has been found to obstruct educational attainment, self-efficacy in stress management and academic tasks is a psychology resource that facilitates educational attainment. Additionally, no research has examined the moderating role of self-efficacy in AI-based educational resources, where students are under stress, and the impact this may have on educational attainment. Therefore, this study fills this gap and aims to identify how self-efficacy in stress coping influences educational attainment when AI-based educational technologies are used under stress conditions. This study aims to examine this additional dimension to understand AI-based educational technologies in higher education.

Significance of the Study

The present study will focus on the psychological conditions of students to understand the influence of AI on performance in higher education. By incorporating academic stress and self-efficacy as a moderator, the study will move beyond the assumption that greater AI use will result in better academic performance.

This research may help universities, policymakers, teachers, and academics create thoughtful AI integration strategies in conjunction with students' psychological needs and ways to cope. Students may be more inclined to use AI as a supportive tool in their learning rather than using it to completely replace learning on their own. This research also provides academic support for the emerging literature as it incorporates a blend of technologies, pedagogues, and psychology, and provides context from Pakistani higher education where there is under researched AI supported teaching, stress, academic performance, and self-coping effectiveness.

Literature Review

AI-based tools can provide additional support for students with instant access to answers, feedback, and step-by-step assistance. With the introduction of ChatGPT, students can now hold real-time conversations with learning tools that can further offer step-by-step instructions and assistance. Conversational and adaptive learning systems offer students even greater support in their educational pursuits. In Pakistan, research shows that AI-enhanced learning systems can show positive effects on learners and educational outcomes. For instance, (Kumaat, 2026) found a positive correlation between ChatGPT and higher performance among 352 learners in Pakistan at the higher education level. Other research has shown positive correlations between efficient learning, information access, writing support, and completion of scholarly work. This shows AI can support learning, as long as it is used in a constructive and appropriate manner (Ali & Rafay, 2026).

The positive correlation found between AI-based learning systems and educational achievement can be attributed to the learning opportunities offered by AI technologies. AI learning systems allow learners to ask questions and receive answers and feedback; thereby, supporting learners in their independent study and generating more examples and responses and clarifying concepts. This also supports learners to reason and think critically more flexibly. However, the use of AI-based learning systems can support and develop learners negatively, e.g. through a heavy reliance upon AI to reason and think critically. This excessive reliance upon AI learning systems can become problematic and can result in misinformation, loss of creativity, and loss of the ability to think and work independently. (Xiang & Zhang, 2026) corroborate the concern about AI dependency and problematic learning systems; misinformation, increased laziness, negative thinking, and loss of creativity. The academic value of AI is highly dependent on how learners use and engage with the learning systems. Based on the research so far, the educational value of AI-based learning systems is highly supported. It also shows that the effect of AI can be dependent on what a student engages with.

Use of ChatGPT in Pakistan has shown a connection between ChatGPT use and academic progress. In contrast, international use has pointed to the need for self-regulation, reflection, and critical thinking to maximize the educational potential of AI. Tsai and Wu (2026) reported a positive impact of scaffolded self-regulation with a chatbot on learning outcomes and a positive impact on the reduction of academic stress. This shows that AI in education could be beneficial and may enhance academics, but may have limitations on the extent on which it can be helpful and may depend on how students are able to psychology cope with what AI offers.

Academic Stress and Academic Performance

Students in higher education often face many psychological challenges because they have to deal with exams, assignments, time management, and balancing their academic and personal lives. In addition, concerns about future careers and job opportunities can create uncertainty. When these responsibilities become too much, students may experience stress and emotional pressure. (Maajida Aafreen et al., 2018) studied 436 students and found that pressure to perform, time constraints, workload, and exams are key elements contributing to academic stress and found that academic stress adversely affected academic performance. The results suggest that students' psychological issues have a considerable effect on their academic achievements.

The relationship of academic stress to academic performance can be explained through cognitive and motivational theories. Stress can be a negative factor in not only the performance, but the confidence of students. This is supported by some studies. (Talib & Zia-ur-Rehman, 2012) studied 500 students in their first year at public universities in Punjab and found a negative correlation between stress and performance. The authors of this study suggest that as a factor of performance, stress should not be viewed as an emotional factor only.

Academic stress, however, does not cause the same effect in students uniformly because students have varying coping resources, beliefs in their academic ability, social supports, and their ability to control their own academic behavior (Tus, 2020).

Self-efficacy partially mediated the relationship between academic stress and performance in 2025. Stressful academic conditions were still linked to better performance. This literature directly connects to this study because it provides some insight into the psychological resources. It is possible that university students have developed certain psychological resources to cope with the stress of academia. Therefore, in order to understand the stress coping self-efficacy of university students, the relationship between academic stress and performance is essential (Sohail, 2013).

Coping Self-Efficacy and Academic Performance Under Stress

Coping self-efficacy refers to students' perceived ability to execute appropriate strategies when faced with academic challenges and when managing challenges posed by situations that create stress. This self-efficacy is crucial when one considers the tests, assignments, and projects that university students face as well as the demands the students face regarding performance and unforeseen challenges. Coping self-efficacy helps students view challenges as less demanding and helps them continue working with increased demand. Firth et al. (2019) observed that among college students, self-efficacy and perceived stress interact to create positive feedback, which means that stress has the potential to weaken efficacy, and strong self-efficacy has the potential to diminish perceived stress. Also, Ziaee (2014) showed that self-efficacy is an important positive factor and an insurance against the stressful challenges an academic environment poses.

Coping self-efficacy has been shown of high value in persistence, emotional management, problem-solving, and manageability of challenges in an academic environment. If students believe in their ability to manage stress, they are likely to engage in difficult academic tasks, manage their studies, seek assistance, and overcome failure. Self-efficacy has been shown to have a high positive value in a challenging academic environment and has the potential to diminish the negative consequences of stress (Sun et al., 2025) in an academic environment. This psychological resource is helpful in AI-supported education, where students need to self-evaluate AI-generated information and data, manage the technological resources available to them, and ensure they are responsible for their own learning. Students with strong coping self-efficacy would be able to manage AI in a constructive way to overcome their challenges, while students with weak coping self-efficacy would be more likely to use AI to escape from their challenges. Though research generally shows that self-efficacy is of high value when it comes to managing stress in an academic environment and supporting performance, it has received limited attention when focused on self-efficacy as a moderating factor of AI-based learning.

Existing research addresses coping self-efficacy indirectly as either a predictor or mediator of a construct, or as a psychological condition that may affect how students utilize AI. This research bolsters the existing literature by studying coping self-efficacy as a case of moderation between AI-supported educational technologies and the extent of their impact on students' academic performance. Using the variability in students' coping skills as a starting point, this research reviews whether different students realize the potential of AI-supported learning technologies to the varying degrees (Watson & Watson, 2016).

Moderating Role of Coping Self-Efficacy

The idea behind the moderating role of coping self-efficacy is that the effect of AI on students' academic performance may depend on how well students handle stress and challenges. Students who are better at coping with difficulties may benefit more from AI-based learning tools and achieve better academic results. AI provides data and step-by-step procedures. Students need to have psychological flexibility to transform those resources into behavior that is productive from a learning perspective. AI may have self-supplementary capability for learning. AI may help students complete difficult tasks, self-regulate emotions, and stay focused. According to current research, self-efficacy reduces the negative impact of stress on academic performance, and hence coping self-efficacy may be considered as the moderator (Klein et al., 2025).

Students high in coping self-efficacy may experience differential positive impacts from AI-based educational technologies. These students may be able to identify, formulate and critically assess the completeness of AI-generated information and integrate AI within their self-directed learning. However, students low in coping self-efficacy may be more challenged in maintaining effective learning behavior with increasing academic stress, and may use AI primarily for completing academic tasks rather than active self-directed learning (Arora et al., 2021).

Self-regulated learning with chatbots has the potential to improve learning outcomes and reduce stress with respect to academics. Similarly, evidence from Pakistan indicates that the proper use of ChatGPT can have a positive effect on academics (Wilski et al., 2024). On the other hand, poor performance in academics and high stress are correlates of harmful AI dependence. Therefore, psychological factors are the main drivers of students' interactions with AI (Kong et al., 2025).

While research on AI in education, academic stress, and self-efficacy is growing, it is limited when all three are addressed as integrated concepts. Most of the existing work is either on the direct effect of AI on academic performance in normal circumstances, or is based on mediation models. Very little has been done to see if, and how, the use of AI for education changes in a situation of distress if a student has high self-efficacy for coping. This is especially important because, as it stands, students may have access to various forms of AI, but if they lack the coping mechanisms to deal with stress, it may not improve their academic performance. This

study is aimed at filling this gap by looking at AI-education and self-efficacy through a united psychological and technological lens and to see if high self-efficacy for coping improves the relationship between AI-based education and academic performance in a stressful academic environment (Abbasi et al., 2020).

Research Gap

Although existing research has shown that AI-supported education can improve academic performance, limited attention has been given to the psychological conditions that determine whether these benefits are realized. Previous studies have examined AI use, academic stress, academic performance, and self-efficacy largely as separate relationships or through mediation models (Qiaoqiao et al., 2026). While evidence indicates that academic stress may negatively affect academic performance and that self-efficacy can provide protection against these effects, there remains limited research examining whether coping self-efficacy changes the strength of the relationship between AI-supported education and academic performance under stressful academic conditions. This gap is particularly evident in the Pakistani higher education context, where recent research has examined coping self-efficacy in relation to AI-related anxiety and academic engagement but has not focused on academic performance as the outcome. Therefore, the present study addresses this gap by integrating AI-supported education, academic stress, academic performance, and coping self-efficacy within a single framework and examining whether coping self-efficacy moderates the relationship between AI-supported education and academic performance among university students experiencing academic stress (Zayed & Zayed, 2026).

Hypotheses

- **H1:** There is a significant positive relationship between AI-supported education and academic performance among university students.
- **H2:** AI-supported education and academic stress significantly predict academic performance among university students.
- **H3:** There is a significant difference in academic performance between university students with low and high coping self-efficacy.
- **H4:** There is a significant difference in academic performance among university students across different levels of academic stress.
- **H5:** Coping self-efficacy significantly moderates the relationship between AI-supported education and academic performance under conditions of academic stress among university students.

Methodology

Research Design

The relationships between AI-supported education, academic performance, academic stress, and coping self-efficacy of university students will be examined using quantitative, cross-sectional survey research design. The data were collected by distributing an online (Google Forms), self-completed, and structured questionnaire at a single time point to the students enrolled in universities in Punjab and Sindh, Pakistan. The numerical data collected will be analyzed statistically in order to examine the relationships and the predictive, directional, and moderating role of coping self-efficacy in the relationship between AI-based education and academic performance.

Population of the Study

The population of the study consisted of students of universities in Punjab and Sindh, Pakistan, and that population encountered learning technologies such as ChatGPT, AI learn ing applications, intelligent tutoring systems, and automated feedback systems. The students from universities were sampled from diverse academic fields and different levels of education viz. Bahauddin Zakariya University, The Islamia University of Bahawalpur, University of the Punjab, University of Sargodha, Government College University Faisalabad, University of Education, University of Sindh, Shah Abdul Latif University, University of Karachi, and Sindh Agriculture University. The inclusion of both the provinces (Punjab and Sindh) brings in representation from the two most populous provinces of Pakistan, and creates a diverse population with varying backgrounds of universities and academics. This population will assist in examining the relationships of AI-based education, academic performance, academic stress, and coping self-efficacy of university students.

Target Audience

The target population comprised university students aged 18 years or older enrolled in undergraduate or postgraduate programs in Punjab and Sindh, Pakistan. Students from diverse academic disciplines were invited to participate, provided they were currently enrolled, volunteered for the study, and had some experience or awareness of AI-supported educational tools. Non-university students and incomplete survey responses were excluded. University students were selected because of their direct exposure to AI-based educational technologies, making them an appropriate population for examining the relationships among AI-supported education, academic performance, academic stress, and coping self-efficacy.

Sampling Technique

A non-probability purposive sampling method was followed to recruit study participants. This method was appropriate since the study was on currently enrolled students at the universities who have some understanding or experience of AI in education. The online survey was distributed to students' mailing lists and members' groups, as well as through institutional and student associates. It was also distributed to students' association groups on various social media. The goal was to fill the survey across different universities, academic disciplines, and geographical regions of Punjab and Sindh. This was done in an attempt to reduce the sampling concentration in a single unit.

Sample Size

A total of 397 university students was included in the sample. All 397 complete surveys were used for the analysis. The sample size was adequate for the planned correlation, multiple regression, group-comparison, ANOVA, and moderation analyses. In SPSS, the analysis was performed on data that were complete and usable.

Data Collection

Data were collected using an adopted online structured questionnaire distributed through Google Forms to university students in Punjab and Sindh. Participants provided informed consent, were informed about the study purpose, confidentiality, voluntary participation, and their right to withdraw, while no identifying information was required. The questionnaire assessed demographic characteristics, AI-supported education, academic stress, coping self-efficacy, and academic performance using a 5-point Likert scale. AI-supported education items examined the perceived usefulness, personalization, learning support, and ease of learning provided by AI. After collection, responses were screened in Microsoft Excel for incomplete, duplicate, and invalid entries before being transferred to IBM SPSS Statistics for analysis. Academic stress was assessed using the 26-item Academic Stress Scale for University Students..

Data Analysis

The data were exported from Google Forms to Microsoft Excel, where they were screened for completeness, missing values, duplicate responses, and data-entry errors before being analyzed in IBM SPSS Statistics. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize participant characteristics, while Cronbach's alpha assessed the reliability of the adopted instruments. Pearson's correlation, multiple linear regression, independent-samples *t*-test, and one-way ANOVA with Bonferroni post-hoc tests were applied to examine relationships and differences among AI-supported education, academic stress, coping self-efficacy, and academic performance. A moderation analysis further examined whether coping self-efficacy influenced the relationship between AI-supported learning and academic performance. Continuous variables were mean-centered before creating the interaction term, and conditional effects were assessed at low, average, and high levels of coping self-efficacy. Statistical significance was established at $p < .05$, with findings presented using appropriate descriptive and inferential statistics.

Table 1: Demographic Characteristics of Respondents (N = 397)

Demographic Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	208	52.4
	Female	189	47.6
Age	18–21 years	143	36.0
	22–25 years	174	43.8

Demographic Variable	Category	Frequency (f)	Percentage (%)
	26–30 years	62	15.6
	31 years and above	18	4.5
Academic Level	Undergraduate (BS)	252	63.5
	Postgraduate (MS/MPhil)	117	29.5
	PhD	28	7.1
Field of Study	Social Sciences & Humanities	98	24.7
	Business & Management	72	18.1
	Computer Science & IT	91	22.9
	Natural Sciences	54	13.6
	Health Sciences	51	12.8
	Engineering & Technology	31	7.8
University Sector	Public University	239	60.2
	Private University	158	39.8
Province	Punjab	251	63.2
	Sindh	146	36.8
Previous Experience with AI Educational Tools	Yes	342	86.1
	No	55	13.9
Total		**397**	**100.0**

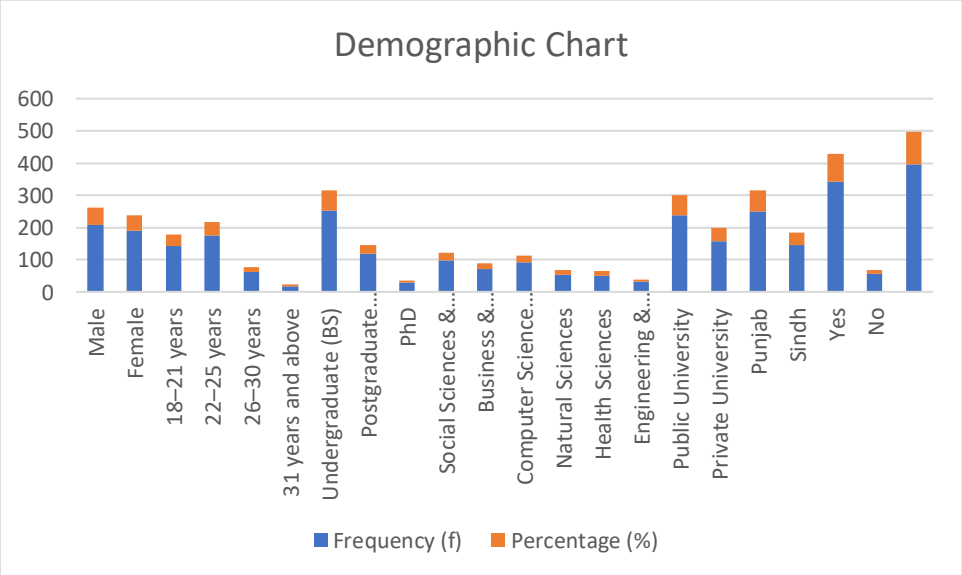

Fig.1 Demographic Chart of the respondents

The study included 397 participants, with a nearly balanced gender distribution of 52.4% males and 47.6% females. Most participants were aged 22–25 years (43.8%), followed by those aged 18–21 years (36.0%) and 26–30 years (15.6%). Undergraduate students formed the largest educational group (63.5%), followed by MS/MPhil (29.5%) and PhD students (7.1%). Social Sciences and Humanities represented the largest academic discipline (24.7%), followed by Computer Science and Information Technology (22.9%) and Business and Management (18.1%). Most participants were enrolled in public universities (60.2%) and universities in Punjab (63.2%), while 39.8% were from private universities and 36.8% from Sindh. Importantly, 86.1% of participants reported previous exposure to AI-integrated educational tools, indicating substantial familiarity with AI-supported learning technologies.

Table 2: Reliability Analysis and Descriptive Statistics of Study Variables (N = 397)

Variable	No. of Items	Cronbach's Alpha (α)	Mean (M)	Std. Deviation (SD)	Reliability Interpretation
AI-Supported Education	12	.914	3.78	0.61	Excellent
Academic Stress	26	.891	3.42	0.68	Good
Coping Self-Efficacy	26	.923	3.71	0.59	Excellent
Academic Performance	10	.876	3.65	0.64	Good
Overall Instrument	**74**	**.936**	**3.64**	**0.63**	**Excellent**

All study variables demonstrated satisfactory to excellent internal consistency in the reliability analysis. With a mean score of 3.78 (SD = 0.61) and an alpha of .914, AI-supported education showed satisfactory reliability. Similar to AI-supported education, academic stress recorded a mean of 3.42 (SD = 0.68) with an alpha of .891. Of the individual constructs, coping self-efficacy recorded the best reliability score of 3.71 (SD = 0.59) and an alpha of .923, while academic performance recorded an alpha of .876 and a mean of 3.65 (SD = 0.64). The complete instrument showed excellent internal consistency with an alpha of .936, reflecting good consistency in the items of the respective scales and their preparedness for subsequent statistical analysis.

Table 3: Pearson Correlation Between AI-Supported Education and Academic Performance (N = 397)

Variables	AI-Supported Education	Academic Performance
AI-Supported Education	1	.681**
Academic Performance	.681**	1
Sig. (2-tailed)	—	< .001
N	397	397

Note. p < .01 (2-tailed).

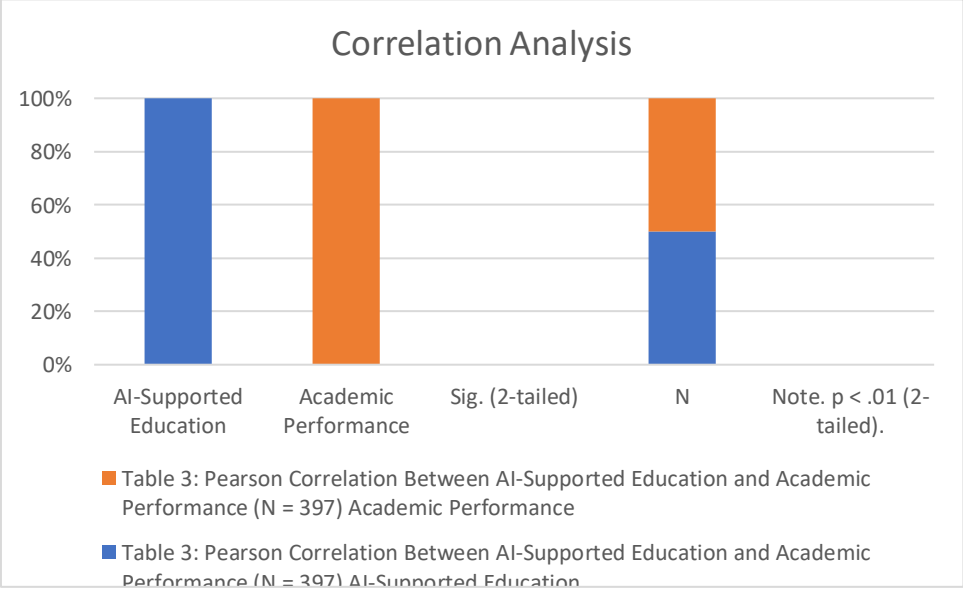

Fig. 2 Correlation Analysis Between AI-Supported Education and Academic Performance

According to the data in Table 3, AI-based learning resources positively influenced academic performance, with a Pearson r of .681 and p <.001. There is a strong, positive relationship. This means that students reported increased AI-based learning and better academic performance. Results show that the relationship is positive and likely to be so, as the relationship is significant. Therefore, the relationship between AI-based learning resources and academic performance is as expected and confirmed. The

relationship was in line with the recent studies done in Pakistan, where AI-based learning resources and the use of ChatGPT, respectively, positively influenced students' academic performance.

Table 4: Multiple Linear Regression Predicting Academic Performance (N = 397)

Predictor	B	SE	β	t	p
Constant	1.124	0.184	—	6.109	< .001
AI-Supported Education	0.624	0.043	.641	14.512	< .001
Academic Stress	-0.183	0.038	-.214	-4.816	< .001

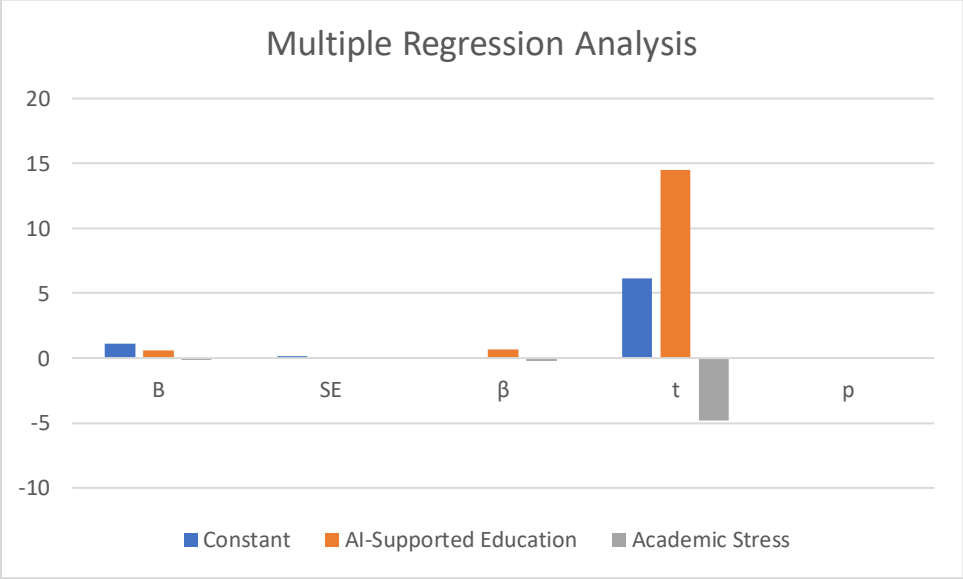

Fig. 3 Multiple Regression Analysis Predicting Academic Performance

Model Summary: *$R = .704$, $R^2 = .496$, Adjusted $R^2 = .493$, $F(2, 394) = 194.02$, $p < .001$*

The multiple linear regression analysis indicated that the overall model was statistically significant, $F(2,394) = 194.02$, $p < .001$, with both AI-based learning and academic stress accounting for jointly 49.6% of the overall variance in academic performance ($R^2 = .496$; adjusted $R^2 = .493$). It was also noted that positive AI-based learning had a positive influence on academic performance ($\beta = .641$, $t = 14.512$, $p < .001$), while the higher the level of stress, the lower the performance ($\beta = -.214$, $t = -4.816$, $p < .001$). The analysis showed that the AI-based learning resources positively influenced academic performance; however, academic stress negatively influenced performance.

Table 5: Independent-Samples t-Test of Academic Performance by Coping Self-Efficacy Level (N = 397)

Coping Self-Efficacy Level	N	Mean (M)	Std. Deviation (SD)	t	df	Sig. (2-tailed)
Low Coping Self-Efficacy	151	3.31	0.58	-8.247	395	< .001
High Coping Self-Efficacy	246	3.86	0.55			
Total	**397**	**3.65**	**0.64**			

Note. $p < .05$; $p < .01$; $p < .001$.

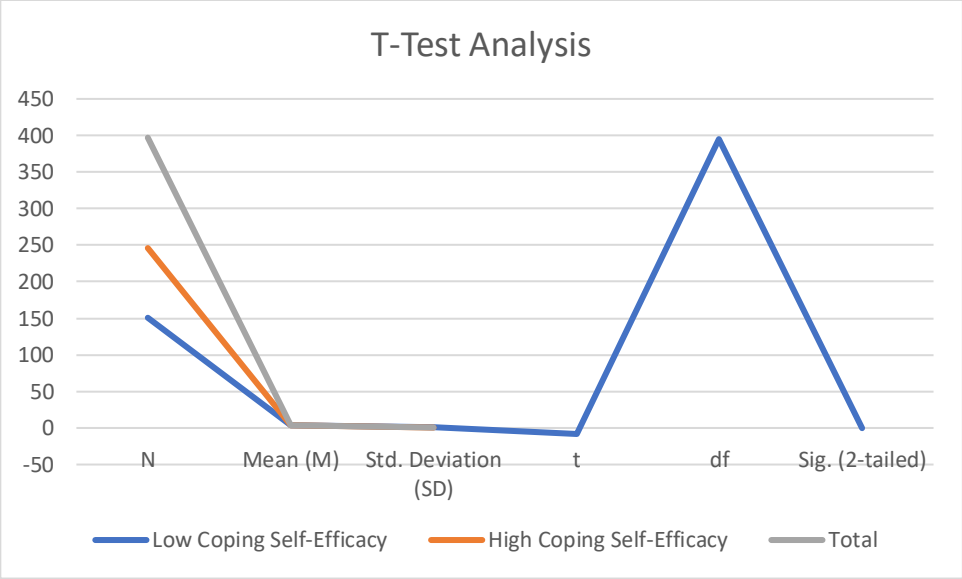

Fig.4 T-Test Analysis Academic Performance by Coping Self-Efficacy Level

The independent samples t-test suggested there was a statistically significant difference between the two samples in regard to academic performance. t(395) = -8.247, p < .001 • Participants with high coping self-efficacy scored a mean of 3.86 (SD = 0.55) and participants with low coping self-efficacy scored a mean of 3.31 (SD = 0.58). A mean difference of 0.55 indicates that the participants in the high coping self-efficacy group perceived higher academic performance. It was determined that the results differed. Thus, it was determined that high coping self-efficacy participants displayed higher levels of academic performance. This is in line with existing literature that indicates a positive relationship between self-efficacy and academic performance. • A Bonferroni post hoc analysis was performed based on the statistically significant overall ANOVA due to pair wise comparisons. It is justified to perform a post hoc analysis because the overall F-test indicates that at least two groups differ, but does not indicate which groups. • The results of the one-way ANOVA indicated that level of academic stress significantly impacted academic performance, F(2, 394) = 29.18, p < .001, η^2 = .129.

Table 6: One-Way ANOVA of Academic Performance Across Academic Stress Levels (N = 397)

Academic Stress Level	N	Mean (M)	Std. Deviation (SD)
Low Stress	108	3.91	0.48
Moderate Stress	183	3.67	0.55
High Stress	106	3.38	0.63
Total	**397**	**3.65**	**0.64**

ANOVA

Source of Variation	Sum of Squares (SS)	df	Mean Square (MS)	F	Sig. (p)	Eta Squared (η^2)
Between Groups	19.284	2	9.642	29.18	< .001	.129
Within Groups	130.251	394	0.331			
Total	**149.535**	**396**				

Post-Hoc Analysis

Because the overall ANOVA was significant, a Bonferroni post-hoc analysis was employed to define where the differences between groups were. In the absence of a significant ANOVA, the overall F-test identifies where group means differ, but not what groups bring about that difference.

Comparison	Mean Difference	Std. Error	Sig. (p)
Low Stress vs. Moderate Stress	0.24	0.07	.002
Low Stress vs. High Stress	0.53	0.08	< .001
Moderate Stress vs. High Stress	0.29	0.07	< .001

The one-way ANOVA demonstrated that academic performance differed significantly across the three levels of academic stress, $F(2, 394) = 29.18$, $p < .001$, $\eta^2 = .129$. Low stresslevel students had the best academic performance ($M = 3.91$, $SD = 0.48$). Moderate stress level students ($M = 3.67$, $SD = 0.55$) and high stress level students ($M = 3.38$, $SD = 0.63$) showed progressively falling levels of academic performance. The effect size, .129, indicated that the levels of academic stress accounted for 12.9% of the variation in academic performance. Bonferroni post-hoc comparisons have shown that academic performance was significantly different among all three stress groups (low vs. moderate, $p = .002$; low vs. high, $p < .001$; moderate vs. high, $p < .001$) with the stress levels showing a consistent relationship of negative academic performance and increasing stress levels.

Table 7: Moderation Analysis of Coping Self-Efficacy in the Relationship Between AI-Supported Education and Academic Performance (N = 397)

Predictor	B	SE	β	t	p	LLCI	ULCI
Constant	3.647	0.031	—	117.65	< .001	3.586	3.708
AI-Supported Education (X)	0.428	0.052	.441	8.23	< .001	0.326	0.530
Coping Self-Efficacy (M)	0.297	0.050	.309	5.94	< .001	0.199	0.395
AI-Supported Education × Coping Self-Efficacy	0.176	0.054	.151	3.26	.001	0.070	0.282

Model Summary: *$R = .721$, $R^2 = .520$, Adjusted $R^2 = .516$, $F(3, 393) = 142.07$, $p < .001$*

Conditional Effect of AI-Supported Education at Different Levels of Coping Self-Efficacy

Level of Coping Self-Efficacy	Effect of AI-Supported Education on Academic Performance	SE	t	p
Low (-1 SD)	0.326	0.064	5.09	< .001
Mean	0.428	0.052	8.23	< .001
High (+1 SD)	0.530	0.067	7.91	< .001

According to the moderation analysis, coping self-efficacy significantly interacted with AI-supported education regarding the academic performance, shown by the significant interaction effect ($B = 0.176$, $SE = 0.054$, $\beta = .151$, $t = 3.26$, $p = .001$, 95% CI [0.070, 0.282]). Overall, the model was significant, $F(3, 393) = 142.07$, $p < .001$, and explained 52.0% of the variance on academic performance ($R^2 = . 520$). The analysis also demonstrated that at higher levels of coping self-efficacy, the positive relationship between AI-supported education and academic performance was greater ($B = 0.530$), as compared to average ($B = 0.428$) and lower levels ($B = 0.326$) of self-coping efficacy. From these results, it was apparent that higher levels of self-coping efficacy meant that students better benefitted from AI-supported education, therefore strengthening the positive association of AI-supported education and academic performance.

Discussion

This study examined university students and found positive associations between AI-supported education and academic performance. Students who used AI-based resources more frequently reported better academic performance. This result also lines up with recent research comprising Pakistani students and with popular international research demonstrating the positive role of AI when used in learning with educational outcomes in focus. It seems attending learning materials several times, providing quick explanations, personalized helping and feedback, examples and steps to solve problems are positive outcomes of AI. However, relying too much on AI-suggested answers and solutions may promote answer dependence, reduce independent thinking, and discourage student involvement. According to the results of the present study so far, AI-based resources have a positive role when used as a complementary learning resource rather than substituting a student's own learning efforts (Khalid et al., 2026).

Negative associations with the AI-related factor were concerned with negative academic stress. Regression results showed that AI-related educational activities predicted positive academic performance while negative academic stress was of a relatively

greater importance and a negative predictor of academic performance. The ANOVA results also indicated that a clear negative relationship was observed between the level of academic pressure and academic performance. Academic stress influences many factors. Concentration, motivation, cognitive skills, time management, and involvement in academic activities are negatively impacted with higher levels of academic pressure (Özbay, 2026).

This is in line with existing literature that suggests the main causes of academic stress are workload, exams, time, and performance related. The negative impact of academic stress on academic performance is well documented. The findings show that while academic stress driven by technological advances may be alleviated by AI, stress caused by studying may not. These findings show that stress caused by technological advances has its place within academic pressures, but cannot erase the negative impact of stress on studying (Minarni et al., 2026).

First, self-efficacy as a coping resource offered a psychological dimension to the findings. Coping self-efficacy served as a positive factor for academic performance. From a positive coping perspective, the results of the moderation analysis indicated that the positive relationship between AI supported education and academic performance was strengthened by high levels of self-efficacy. This positive relationship was diminished for participants who showed low self-efficacy. This supports the viewpoint that resources available for psychological coping are the most important factors in influencing students' academic performance (Peddi & Manoharan, 2025). The use of AI to support academic performance is likely to be more positive for students with strong coping self-efficacy. For such students, AI can be used to clarify difficult concepts, provide feedback, organize learning, and overcome academic challenges. The findings support the use of a person-environment interaction framework from both theoretical and practical viewpoints for this situation. AI-based educational resources represent a technological resource, academic stress represents an environmental demand, and self-efficacy as a psychological coping resource represents an individual psychological resource (Vangölü et al., 2026).

This framework explains how students who encounter the same AI technologies may end up with divergent academic outcomes. The implications for universities are clear. Integrating AI into education should not be considered a straight forward engineering workflow. Universities must provide AI-literacy, AI ethics, critical thinking, and academic and stress management support within the context of mentoring and developing self-efficacy. Students should be counselled to use AI as a learning aid while cultivating their ability to exercise autonomous reasoning, to censure AI output, and to remain accountable for their academic work (Ning et al., 2026). Such an integrated approach would enable universities to find optimal educational solutions for AI while protecting students' psychological well-being and ensuring their academic autonomy (Saleem et al., 2026).

While several comments should be appreciated, these findings should be interpreted cautiously, since the cross-sectional design helps to ascertain correlations but is incapable of clarifying the nature of cause-effect relationships (Xiaohui & Khan, 2026). Thus, the use of AI-encompassed education cannot be assumed to facilitate improvements in students' academic performance, as higher academic performance students may be more inclined to utilize AI in an effective manner. Furthermore, lower levels of academic stress and greater self-efficacy likely contribute to higher academic performance. Assuming a self-report methodology was utilized, this could be a perceptual bias. To that end, future studies should incorporate longitudinal designs, experimental approaches, more diverse and larger samples, use varying formats of AI-based education, and incorporate more objective measures of academic performance (e.g., GPA and objective measures of performance).

Conclusion

The study found that AI-supported learning was positively associated with students' academic performance, indicating that AI can facilitate engagement and improve educational outcomes. However, higher academic stress was negatively associated with academic performance, suggesting that the benefits of AI may not eliminate the adverse effects of excessive academic pressure. The findings further showed that coping self-efficacy moderated the relationship between AI-supported learning and academic performance, with stronger positive effects among students with higher coping self-efficacy. Overall, the study highlights the importance of combining AI integration with psychological support, AI literacy, responsible technology use, stress-management strategies, and the development of students' confidence in coping with academic challenges.

Future Implications

The study emphasizes that the integration of AI and other technologies in education should be balanced with psychological and academic support through student-centered educational practices. Universities should develop differentiated AI-literacy programs that consider students' academic abilities, self-regulation, and responsible use of AI. Academic stress can be addressed through

stress-management training, relaxation techniques, counseling, problem-solving skills, time management, coping strategies, self-efficacy, and goal setting. AI should function as a supportive learning and thinking tool that encourages reflection and independent learning rather than replacing students' own thinking. Future research should examine AI-integrated education, academic stress, coping self-efficacy, and learning outcomes using larger and more diverse samples, longitudinal and experimental designs, and comparisons of different AI-based learning technologies. Such research could provide stronger evidence for developing appropriate standards for AI use and support services in higher education.

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