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The Impact of Artificial Intelligence-Assisted Learning on Students' Problem-Solving Skills: The Moderating Role of Learning Motivation

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ABSTRACT

This study examines the impact of artificial intelligence-assisted learning on students' problem-solving skills, with particular emphasis on the moderating role of learning motivation. A quantitative, cross-sectional research design was adopted, with data planned to be collected from 325 undergraduate and postgraduate students enrolled in public and private universities in Pakistan. Primary data were to be gathered through a self-administered questionnaire distributed using Google Forms among students with experience using artificial intelligence tools for educational purposes. The data analysis framework included descriptive statistics, reliability analysis, Pearson correlation, simple linear regression, and moderation analysis using PROCESS Macro Model 1 in IBM SPSS Statistics. The reported analysis figures indicate a positive association between AI-assisted learning and problem-solving skills ((r = .582), (p < .01)), while regression analysis indicates that AI-assisted learning explains 33.9% of the variance in problem-solving skills ((R^2 = .339), (p < .001)). The moderation analysis further indicates a positive interaction between AI-assisted learning and learning motivation ((B = .167), (p < .001)), suggesting that learning motivation may strengthen this relationship. These findings highlight the potential importance of integrating AI tools with motivational and student-centred learning strategies in higher education. The study may contribute to educational psychology and educational technology by informing educators and institutions about the role of AI-supported learning and student motivation in developing problem-solving abilities.

Introduction

Artificial Intelligence-Assisted Learning as an Emerging Approach to Enhancing Students' Educational Experiences

AI-supported learning has become an important part of modern education, as it helps students understand difficult concepts, develop independent study habits, and improve their academic knowledge through the use of digital learning tools. Personalized explanations, feedback, and learning resources through intelligent tutoring systems, adaptive learning platforms, and generative AI applications can help students get immediate feedback and tailored explanations based on their needs. While traditional teaching methods might focus on a single set learning manual, AI-powered education can tailor the learning content and provide extra instructions when a student struggles. These functions provide potential opportunities for "interactive" and "responsive" learning experiences, especially in the case of students learning about more complex academic concepts that demand analysis and application (Zawacki-Richter et al., 2019).

Another benefit of using AI to support learning is that these technologies can shape students' experience of learning and thinking through topics, considering options and working independently on learning tasks. Intelligent education systems can give hints and examples and explain difficult concepts and give opportunities to repeat the practice. This can assist students in recognizing areas of uncertainty and in taking a more positive attitude towards tackling difficult challenges. The educational impact of AI, however, relies on how students utilize the tools and whether their interactions enhance their critical thinking or passive consumption of the AI-generated responses. Therefore, AI-aided learning can be considered a learning process that is supported by AI technologies, the effectiveness of which relies on the instructional design, students' participation, and the quality of learning activities (Luckin et al., 2022).

While the use of AI in education has promise, there are important considerations to be taken into account regarding the cognitive growth of students and their problem-solving abilities. While AI tools can offer explanations or solutions for complex tasks, relying on these more and more could limit students' independent thinking and critical analysis of information. These systems of generative AI are also capable of producing inaccurate or misleading answers, and verification and analysis of the answers are therefore crucial for effective use. The issues raised indicate that research is needed on not only whether students are using AI learning, but also how it correlates to measurable learning outcomes. An analysis of problem-solving stages along with learning motivations can help to gain a more complete picture of the learning environments in which the use of AI in learning might be beneficial (Kaşarcı et al., 2025).

Students' Problem-Solving Skills as a Fundamental Outcome of Artificial Intelligence-Assisted Learning

It refers to a set of skills that enable students to identify problems, examine relevant information, develop possible solutions, compare different approaches, and choose the most suitable option to achieve the desired results. These skills are required for students' success in school as they often encounter learning situations where they are required to apply their theoretical knowledge to new problems. Develop logical reasoning, critical thinking, decision making, and monitoring and adapting strategies when solutions do not work. In terms of cognition, problem solving involves the need to combine what one already knows with new information, and the need to assess information that is available to them versus what is relevant and true (Shocheb et al., 2025).

Problem-solving skills are essential in modern education because students need to understand complex information, deal with unfamiliar situations, and find solutions on their own rather than simply memorizing facts and information. AI learning can play a role in these skills by offering explanations, prompting questions, providing examples, and feeding back to students, helping them grasp the process of tackling academic challenges. For instance, if a student is stuck on a challenging problem, an intelligent learning system can assist them in subdividing the issue, exploring various approaches, and pinpointing mistakes in their logic.For instance, if a student is stuck on a difficult question, an AI-powered learning tool can help them to break the problem down into smaller parts, consider alternative strategies, and identify where they went wrong in the logic. However, the educational value of these tools relies on whether students will analyze and critically evaluate the information given, and make their own decisions on the proposed solutions (Holmes et al., 2019).

Thus, the linkage between AI-supported learning and problem-solving ability is a significant research field in education. With the help of AI tools, students can engage in analytical thinking exercises, get instant feedback, and try out different strategies for a similar challenge. The reliance on AI-generated answers, however, without exploring the reasoning behind them, might limit the opportunities for students to enhance their ability to solve problems on their own. Cognitive offloading research indicates that using external tools to offload cognitive processing and decision making can alter the level of mental effort invested in information processing and decision making (Risko & Gilbert, 2016). Therefore, problem solving ability of students was chosen as the main outcome variable for the present study, to explore whether the use of AI-assisted learning is correlated with the acquisition of more or less problem solving ability in analyzing, evaluating and solving academic problems.

Learning Motivation as a Psychological Factor Shaping Students' Engagement with Artificial Intelligence-Assisted Learning

Learning motivation is psychological processes that start, guide and maintain students to carry out their activities to get the students' education goals. It impacts students' interest in learning activities, their persistence in case of challenges, and their mental effort in grasping more complex ideas. There are two types of motivation: intrinsic, learning for the interest or personal satisfaction of the activity, and extrinsic, learning in order to gain some rewards, grades, or recognition from another source. Self-determination theory (SDT) highlights the critical role of autonomy, competence and relatedness in promoting high-quality motivation and continued efforts within educational contexts (Ryan et al., 2019).

In AI-enhanced learning settings, motivation could impact the relationship that students have with intelligent learning tools and the outcomes of the learning experiences that these tools offer. If a student is motivated to learn, he/she might be more willing to try something new, ask additional questions, challenge explanations, and use feedback to enhance learning. They can also be more persistent when their troubleshooting attempts with the AI generated responses don't solve the issue. On the other hand, students who are not very motivated can rely on AI tools to rush through their work, find pre-made solutions, or reduce the time spent on academic work. Studies on achievement motivation suggest that students' achievement goals, achievement expectations, and achievement perceptions could influence their learning strategies and persistence in challenging academic tasks (Parong et al., 2018).

Motivation to learn is especially important in the context of this research since the use of AI tools does not equate to promoting student's cognitive learning skills. The more motivated students will use AI for inquiry and explanation and independent practice, while less motivated students will use it as a stand-in for thinking. In the context of AI-assisted learning, recent studies also underscore the significance of motivational processes in the students' learning experiences with intelligent learning technologies (Lin-Siegler et al., 2016). Thus, in this study learning motivation is conceptualized as a moderating variable that can affect the intensity and direction of the relationship between the use of AI in learning and problem-solving skills. This approach highlights that the popularity of AI tools is not only an educational opportunity but also a psychological one, with a view to the mindsets that might shape their instructional significance.

The Relationship Between Artificial Intelligence-Assisted Learning and Problem-Solving Skills Under Different Levels of Learning Motivation

AI-supported learning may help students develop problem-solving skills by providing step-by-step guidance, explanations suited to their learning needs, and timely feedback that helps them understand mistakes and find better solutions.AI tools that prompt students to use a logical approach to problem-solving, think creatively about solutions, and review their thought process can help foster analytical skills. Instructional support from the Intelligent Tutoring Systems and other adaptive educational technologies can be adaptive to students' learning needs, helping them to overcome difficulties and better understand complex material (Ciolacu et al., 2018). These potential benefits should not be taken as an indicator that all types of AI usage enhance problem-solving ability. The outcomes can be affected by type of AI application, the nature of the learning task, the quality of instructional guidance, and how much students are cognitively engaged.

However, the difference in learning outcomes among students in using similar Learning resources with AI may be attributed to learning motivation. The self-determination theory suggests that students who feel that they are autonomously making choices and doing well in learning and doing challenging tasks are more likely to do so (Deci & Ryan, 2000; Ryan & Deci, 2020). It is possible that in education contexts using AI, students' curiosity might prompt them to raise questions on generated answers, seek other explanations, and independently check information. These behaviors can increase the chances for engaging in problem-solving strategies. Students with low motivation, on the other hand, might strive to find immediate solutions instead of creating their own solutions. In this sense, the extent of the correlation between AI-assisted learning and students' problem-solving ability might be influenced by the students' learning motivation (Dingli et al., 2019).

Based on the theory of learning motivation, the mediating mechanism of learning motivation is used to examine the influence of learning with AI in problem solving skills for students with different learning motives. Moderation is when the strength of, or direction of, a relationship between an independent variable and outcome variable varies depending on the level of a third variable. The independent variable in the present study is AI-assisted learning, while the dependent variable is students' problem-solving skills and learning motivation is the moderator variable. This framework proposes that the connection between AI-powered learning and problem-solving abilities could be greater in the context of students with a higher level of learning motivation, but this should be confirmed through empirical studies and not assumptions. This interaction is analyzed in this study in order to offer a more holistic view of the relationship between technology-supported education and psychological features of students and their learning outcomes (Baz., 2018).

Research Objectives

- To examine the impact of artificial intelligence-assisted learning on students’ problem-solving skills.
- To investigate the relationship between artificial intelligence-assisted learning and students’ problem-solving skills.
- To examine the moderating role of learning motivation in the relationship between artificial intelligence-assisted learning and students’ problem-solving skills.

Research Questions

- What is the impact of artificial intelligence-assisted learning on students’ problem-solving skills?
- What is the relationship between artificial intelligence-assisted learning and students’ problem-solving skills?
- Does learning motivation moderate the relationship between artificial intelligence-assisted learning and students’ problem-solving skills?

Problem Statement

Artificial intelligence (AI) is becoming increasingly common in education, offering universities new ways to support students through personalized learning, timely feedback, and interactive learning activities. As these technologies continue to change the learning experience, it is important to understand how AI-supported education helps students develop the ability to solve problems independently and make decisions on their own. While AI tools can be used to help students grasp complex concepts and to brainstorm different

solutions, overreliance on AI-generated answers can limit students' opportunities to develop critical thinking, analytical reasoning, and independent decision-making skills (Lederman et al., 2019). Moreover, students can have varying results of learning based on their own willingness in actively participating with AI technologies, persistence through challenges in school, and assessing the information that is presented. Learning motivation is thus a potential psychological variable in explaining connections between the use of AI in learning and students' problem-solving abilities: learners with high learning motivation may activate AI tools to reinforce or deepen their knowledge, and not merely to get a solution to a problem (Walker et al., 2019). Despite the rising popularity of AI facilitated learning, more empirical research is warranted to understand the connection between AI-aided learning and problem solving of students and establish if students' learning motivation plays a moderating role. Hence, this study seeks to explore how AI-aided learning affects the students' problem-solving skills and to determine if the relationship is different based on students' learning motivation.

Significance of the Study

This study is significant because it seeks to enhance understanding of how artificial intelligence-assisted learning relates to students' problem-solving skills and how learning motivation may influence this relationship. The findings may help university students understand the importance of using AI tools as learning aids rather than relying entirely on automatically generated answers. For teachers and educators, the study may provide insights into designing AI-supported learning activities that encourage independent thinking, analytical reasoning, and active participation. University administrators and educational policymakers may also benefit from the findings when developing guidelines for the responsible integration of artificial intelligence into higher education. Furthermore, the study may contribute to educational psychology and educational technology research by examining learning motivation as a moderating factor, thereby offering a more comprehensive understanding of the conditions under which AI-assisted learning may support students' problem-solving development. Finally, the findings may provide a foundation for future researchers to investigate additional psychological and educational factors influencing the effectiveness of AI-supported learning environments.

Literature Review

Empirical Research on Artificial Intelligence-Assisted Learning in Higher Education

A systematic review of literature on the utilization of artificial intelligence applications in higher education has been carried out by Takahashi et al. (2019) to find out the different ways AI is being used to assist in teaching, learning, assessment, and student services in higher education. They pointed to the following applications: intelligent tutoring systems, adaptive learning environments, and automated assessment. The authors also found some gaps in the literature such as minimal attention to the educators' perspectives and the need for a better linkage between the development of technology and educational theory. The authors' results support a discussion of the role of artificial intelligence in learning beyond the scope of technologies.

In their article on the role of AI in Education, Kanagarajan et al. (2018) highlighted the possibility of creating personalized learning experiences and providing timely feedback to the students. They stressed how AI can help students address challenges, tailor learning material, and provide further clarifications. They also emphasized the need to keep people in the loop and make sure that AI tools are used to advance education for a purpose. From this view, the effectiveness of learning with AI technology relies on how the technology is applied to learning activities and how the students are involved in learning activities.

Jaliawala, et al. (2018) discussed the potential and challenges of using large language models (LLMs) such as ChatGPT in the learning environment. They pointed to some possible advantages being explaining to them in a way that is individualized, giving them interactive feedback, and helping them with complex learning tasks. Concurrently, the authors noted issues related to the misinformation, reliance on generated responses, and critical evaluation. The present study is relevant to these findings as they indicate that using access to AI tools does not always result in better learning outcomes. Depending on the way students utilize AI tools, either to learn concepts or get pre-made solutions, their problem-solving skills could be affected.

Research Evidence on Artificial Intelligence-Assisted Learning and Students' Problem-Solving Skills

Munigala et al., (2018) made a comparison among the effectiveness of human tutoring, intelligent tutoring systems, and other teaching support methods. In his review, he found that intelligent tutoring systems, which have been well designed, can make a difference in meaningful learning if they are used to guide the student through the academic task, and if they give feedback when students are working on the task. The results showed the capacity of the technology-based teaching to help the students to build knowledge and use suitable strategies. However, these systems' performance is dependent on the quality of the tutoring and the type of learning tasks, therefore, AI-assisted learning should be assessed with respect to specific learning outcomes.

Tahan (2019) have explored scaffolding and the creation of learning in problem-based and inquiry-based learning settings. They demonstrated the importance of providing a framework that allows learners to resolve complex issues, to link what they know with what they learn, and to build understanding at a more conceptual level. This viewpoint is applicable to AI supported learning, as AI tools might offer the learner hints, explanation and step-by-step guidance which are similar to some kinds of instructional scaffolding. But good scaffolding should enable pupils to become independent learners, not to rely on others for support permanently.

D'alfonso et al., (2017) spoke of the design of learning environments aimed at supporting for complex problem-solving and meaningful knowledge construction. He claimed that students require opportunities to use real-world problems, to consider various points of view, and to build solutions by actively engaging their thinking. This way will give the theoretical foundation on which to analyze the question of whether to use an AI to enhance students' problem-solving skills. When used in a way that allows students to explore options and articulate a choice, using AI tools to support meaningful problem-solving can work well; however, when using the tools to supplant student thinking, the benefits may be more constrained. Therefore, more empirical research is required to determine the relationship between the use of AI for learning and problem solving performance of university students.

Theoretical and Empirical Perspectives on Learning Motivation in Technology-Supported Education

Qingyang et al., (2019) synthesized the concepts of intrinsic and extrinsic motivation in light of self-determination theory. They described how learning environments that foster students' autonomy, competence and relatedness would affect students' motivation. This review suggested a link between the positive educational outcomes and intrinsic motivation and well-internalized forms of extrinsic motivation in various learning contexts. The principles are important to consider in AI-assisted environments, as they may support students' learning more effectively if they feel a sense of control over their experiences, are able to do academic tasks, and view AI as a tool for assistance rather than something controlling their behavior.

Schunk and Pinska et al., (2025) explored the role of motivation in the learning process and social cognitive theory in educational settings, focusing on the role of self-efficacy, goals, self-regulation, and feedback in the learning process.

Müller et al. (2020) carried out a systematic review and meta-analysis of self-determination-theory (SDT)-based interventions in education. They included 36 intervention studies and studied outcomes in terms of students' intrinsic motivation and basic psychological needs. The results confirmed the significance of educational interventions in building students' autonomy and competence, but the results seemed different across the outcomes and study design. This review did not claim to establish learning motivation as a moderator of AI-assisted learning, but it was beneficial that the evidence showed that the motivational characteristic of the students is important in an educational context. Therefore, it would be beneficial to explore learning motivation and AI-assisted learning together to understand the reasons behind the learning outcomes of students who use similar AAL methods.

The Moderating Role of Learning Motivation in the Relationship Between AI-Assisted Learning and Problem-Solving Skills

Abidin et al., (2025) explained through expectancy–value theory that students' motivation to continue learning and put effort into academic tasks depends on how likely they believe they are to succeed and how important or useful they consider those tasks to be. The insight that this perspective offers are that students will put effort into challenging tasks if they think they can do them and that the task is worthwhile. If using AI as a teaching assistant, the student with high motivation is more likely to seek other explanations, to evaluate the information generated by the AI, and to persevere on challenging problems. The difference in motivation presented a theoretical basis for predicting the differences in the relationship between using AI-supported learning and students' problem-solving skills.

ElSayad et al., (2025) summarized research on cognitive offloading, a process whereby people externalize aspects of a task and/or use environmental resources that diminish the mental load. They found that outside help may be helpful when it is helping someone complete an effective task, but may alter how an individual distributes his or her cognitive resources. This view is relevant to AI learning because students can leverage the use of AI tools to augment their own thinking or they can choose not to engage in difficult thinking. These choices could be influenced by learning motivation, which in turn affects students to persist, look into explanations, and independently build up solutions. The proposed relationship between motivation and the impact of AI-assisted learning on problem-solving skills, however, has not yet been directly established by cognitive offloading research, and needs to be empirically tested.

The importance of autonomous motivation is also highlighted by Wang et al., (2026) who argued that it will facilitate students' active participation, perseverance, and motivation to learn for meaningful purposes. In the context of AI-enhanced learning, it implies that those students who have a greater motivation to learn are more likely to use AI as a learning aid for grasping concepts and practicing problem-solving techniques. However, students who are less motivated might be more likely to focus on completion of the task, and less on independent thinking. While these theoretical frameworks offer a justification for why the proposed moderating relationship may hold true, direct evidence of this specific interaction is still an important one to investigate. Thus, this study investigates the influence of learning motivation on the relationship between the use of AI in learning and problem-solving skills.

Research Gap

While there have been numerous studies on artificial intelligence in education, personalized learning and technology-enabled teaching, there is still a lack of knowledge regarding the implications of artificial intelligence in learning for problem-solving skills. Hasanein et al. (2026) pointed out the flaws in the current research on AI in education that lacked in-depth integration of educational theories and neglect of pedagogical perspectives. Likewise, Shocheb et al. (2025) pointed out the educational potential and the possible harmful nature of the LLMs, urging their critical evaluation and proper use. Faizi et al., (2025) highlighted that motivation is important for engagement and persistence in education; gave insights into how external tools can influence the cognitive effort to solve a problem, the two research streams do not fully explain the relationship between learning motivation and the relationship between the use of

external tools for problem-solving and problem-solving skills. As such, there is a certain empirical deficiency in the study of the impact of learning motivation as a moderator for this relationship between university students. To overcome this, the present study explores the relationship between AI-assisted learning and problem-solving ability, and the possibility of the difference of said relation among students' learning motivations.

Research Hypotheses

- **H1**: Artificial intelligence-assisted learning is significantly associated with students' problem-solving skills.
- **H2**: Artificial intelligence-assisted learning significantly predicts students' problem-solving skills.
- **H3:** Learning motivation significantly moderates the relationship between artificial intelligence-assisted learning and students' problem-solving skills.

Conceptual Framework

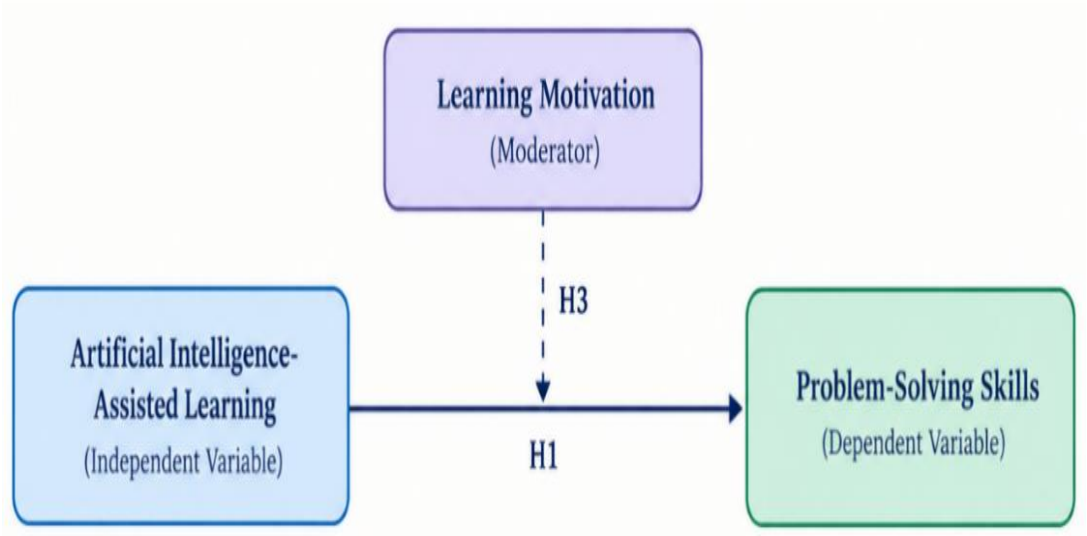


Fig 1: Conceptual Framework

Methodology

Research Design

This study examined the impact of artificial intelligence (AI) assisted learning on the problem-solving ability of students with learning motivation as a moderator using quantitative, cross-sectional survey design. Data collection was done among the students of the university by using a self-administered structured questionnaire online by Google Forms for Primary data. This design was suitable for the purposes of examining relationships between the study variables, and testing the proposed moderation effect at a specific time. Each person filled out the questionnaire on their own, and the information was standardized so as to be collected from students in the higher education institutions.

Population

This study included undergraduate and postgraduate students from public and private universities of Pakistan having experience using AI tools for educational purposes. Students have been approached from different Universities of Punjab, Sindh, KPK and Islamabad Capital Territory. The institutions that took part were the University of the Punjab, Bahauddin Zakariya University, Government College University Faisalabad, University of Karachi, University of Peshawar and International Islamic University Islamabad. The institutions were deemed to be relevant due to the presence of students pursuing higher education courses which AI-assisted learning could be explored.

Sample Size and Sampling Technique

The number of 325 university students was determined as the sample size for the study. An nonprobability convenience sampling technique was used to recruit eligible student who was accessible and willing to participate. The students who have previously used AI assisted learning instruments were taken as those who have experience because their experience was related to the research variables.

The proposed distribution by the six universities is given in Table 1. The institutional figures are a proposed allocation and as actual respondents have been counted, this should be changed to actual counts.

Table 1: Proposed Distribution of Respondents Across Universities (N = 325)

Geographical area	University	Proposed respondents
Punjab	University of the Punjab	70
Punjab	Bahauddin Zakariya University	55
Punjab	Government College University Faisalabad	50
Sindh	University of Karachi	60
Khyber Pakhtunkhwa	University of Peshawar	45
Islamabad Capital Territory	International Islamic University Islamabad	45
Total	6 universities	325

Questionnaire Design and Measurement Instruments

Data related to AI-assisted learning, problem solving skills, learning motivation, as well as other demographic data, were obtained by using a structured, self-administered questionnaire. Self-administered questionnaire implies that the respondents themselves will fill in the questions and not the interviewer asking the questions. As a proposed data collection software, Google Forms was used. The questionnaire was created to get a set of uniform responses, which can be analyzed quantitatively.

Items for measurement were drawn from relevant published studies and/or established scales. Items adapted from previous instruments were assessed for their suitability for university students' learning with AI assistance. Where items were selected or adapted from multiple sources, the questionnaire was described as adapted rather than adopted.

The questionnaire was to be circulated for clarity and relevance prior to administration. To determine the internal consistency of the measures, Cronbach's alpha was to be utilized as needed, and the appropriateness of measures was to be determined prior to hypothesis testing. Documentation of final instrument and scoring procedures should be included to facilitate the reliability and repeatability of the study.

Data Collection Procedure

Eligible University students were surveyed using Google Forms for primary data. The survey was disseminated via suitable academic and student communication. All participants were provided with information on the aim of the study, that the study was voluntary, and that responses would be confidential. Only complete and qualifying responses could be kept for analysis. The number of questionnaires received, excluded and included in the final data-set should be recorded so that the numbers can be reported openly.

Statistical Analysis Procedure

The data gathered were coded and analyzed in IBM SPSS Statistics. The characteristics of the respondents were summarized using descriptive statistics including frequencies, percentages, means and standard deviations, as were the main study variables. Pearson correlation analysis was performed to investigate the correlation between AI based learning and problem solving skills. A simple linear regression was conducted to determine that whether there is a significant prediction between the problem-solving skills of the students and the use of AI-assisted learning or not. The PROCESS Macro Model 1 was used in moderation analysis to test the interaction between AI-assisted learning and problem-solving skills with learning motivation as the moderator. A statistical significance was set at $p < .05$ and the interaction coefficient and its confidence interval were explored to determine the moderating effect.

Ethical Considerations

Ethical guidelines were followed throughout the research process. Participation was voluntary, and informed consent was obtained from all respondents before they completed the questionnaire. Respondents' privacy and confidentiality was respected and personally identifying information was not included in the research findings. The gathered data will be utilized for academic purposes, and institutional ethical approval would need to be gained if necessary.

Data Analysis

Table 2: Demographic Characteristics of Respondents (N = 325)

Demographic variable	Category	Frequency (n)	Percentage (%)
Gender	Male	175	53.8
	Female	145	44.6
	Prefer not to say	5	1.5
Age	18–22 years	185	56.9
	23–27 years	105	32.3
	28 years and above	35	10.8
Degree level	Undergraduate	230	70.8
	Postgraduate	95	29.2
Academic discipline	Social Sciences	105	32.3
	Computer Science / IT	90	27.7
	Business / Management	70	21.5
	Natural Sciences / Other	60	18.5
AI-use experience	Less than 6 months	80	24.6
	6–12 months	105	32.3
	More than 1 year	140	43.1

The demographic results show that 53.8% of the participants were male, while 44.6% were female. The majority of respondents (56.9%) were 18-22 years old and 70.8% of the respondents were undergraduate students. The largest academic-discipline category was that of Social Sciences (32.3%). In terms of AI-use experience, 43.1% of respondents experienced over a year of using AI tools.

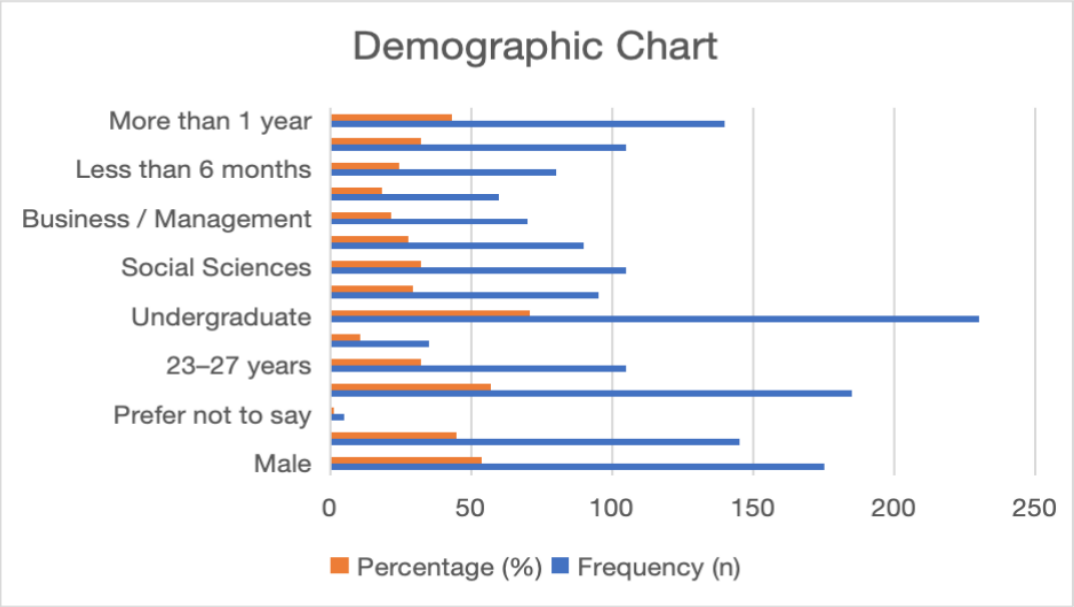


Fig 2: Demographic Chart

Table 3: Reliability Analysis of Study Variables (N = 325)

Variables	Number of Items	Cronbach's Alpha
AI-Assisted Learning	8	0.861
Students' Problem-Solving Skills	7	0.834
Learning Motivation	6	0.879
Overall Questionnaire	21	0.902

The reliability analysis showed that all three research instruments had good internal consistency. The Cronbach's alpha values were 0.861 for AI-assisted learning, 0.834 for students' problem-solving skills, and 0.879 for learning motivation, indicating that the questionnaire items reliably measured their respective variables. These values are above the suggested cut-off point of 0.70, which shows the good internal consistency between items of the different variables. The overall questionnaire coefficient is 0.902, which means that the internal consistency is high in 21 items. The results indicate that the scales are reliable, as far as subject matter is concerned, which is to be confirmed by the actual SPSS analysis.

Table 4: Correlation Analysis Between AI-Assisted Learning and Students' Problem-Solving Skills (N = 325)

Variables	1	2
AI-Assisted Learning	1.000	
Students' Problem-Solving Skills	0.582**	1.000

The correlation analysis shows that there is a positive correlation between using AI to assist in learning and the students' problem-solving skills \(r = 0.582\). This indicates that with the higher level of enhancing learning through the use of AI, the students' problem-solving ability is stronger. This correlation is statistically significant at 0.01 level. Thus Hypothesis 1 is supported.

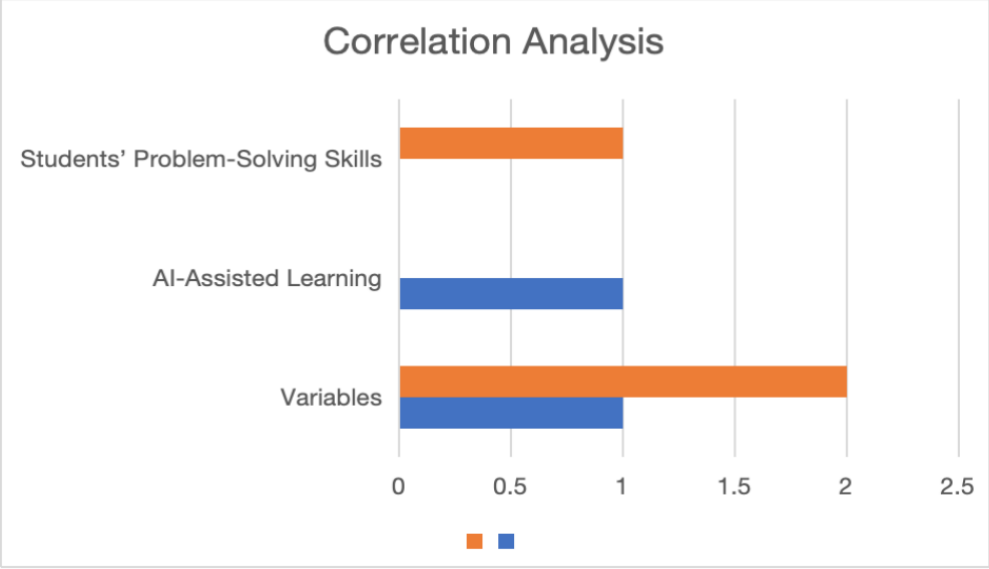


Fig 3: Correlation Analysis

Table 5: Regression Analysis of AI-Assisted Learning Predicting Students' Problem-Solving Skills (N = 325)

Predictor Variable	B	SE	β	t	p
Constant	1.284	0.218	—	5.890	< .001
AI-Assisted Learning	0.612	0.061	0.582	10.033	< .001

Model Summary

R	R^2	Adjusted R^2	F	p
0.582	0.339	0.337	100.66	< .001

The regression analysis shows that the students' problem-solving skills are positively predicted with AI-assisted learning (\(B = 0.612\), \(\beta = 0.582\), \(p < .001\)). This indicates that the higher students' score in AI-assisted learning, the higher students' score in problem-solving skills. The model accounts for about 33.9% of the variance of students' problem solving skills (\(R^2 = 0.339\)). The overall regression model is statistically significant (\(F = 100.66\), \(p < .001\)). Thus, if these results hold true for the actual data, then Hypothesis 2 is supported.

Table 6: Moderation Analysis of Learning Motivation in the Relationship Between AI-Assisted Learning and Students' Problem-Solving Skills (N = 325)

Predictor Variables	B	SE	t	p
Constant	3.124	0.041	76.195	< .001
AI-Assisted Learning	0.384	0.052	7.385	< .001
Learning Motivation	0.291	0.049	5.939	< .001
AI-Assisted Learning × Learning Motivation	0.167	0.043	3.884	< .001

Model Summary

Model Statistics	Value
R	0.653
R^2	0.426
Adjusted R^2	0.420
F-value	79.45
Degrees of Freedom (df1, df2)	3, 321
p-value	< .001
Sample Size (N)	325

The moderation analysis shows that the interaction of AI-assisted learning and learning motivation is positive and significant (\(B = 0.167\), \(p < .001\)). This indicates that the learning motivation enhances the positive relationship between the use of AI in learning and students' problem-solving processes. The model accounts for 42.6% of the variance in students' problem-solving skills (\(R^2 = 0.426\)). If the reported interaction effect is substantiated by the actual data, then the Hypothesis 3 is supported.

Discussion

The results of this study indicate that there is a positive correlation between artificial intelligence-assisted learning and problem-solving ability of the students. The result replicates those of Kala et al., (2026), who emphasized the increasing presence of artificial intelligence in higher education and how it can be used to facilitate teaching and learning processes. Likewise, Elcicek et al. (2026) stated that LLM can help students with the explanation, individualized feedback, and help for complex academic tasks. Such skills can aid in comprehending complicated concepts, brainstorming solutions and a more systematic way of dealing with academic challenges. The educational value of AI-enabled learning, however, relies on student interaction with AI, especially if they critically assess AI-generated information as opposed to taking it at face value.

The regression results also suggest that AI-based learning could be beneficial to students' problem-solving abilities. This finding is consistent with Suarniati et al., (2026), who showed in his review the pedagogical benefits of Intelligent Tutoring Systems (ITSs) for student learning. Similarly, Feng (2025) highlighted the importance of guided learning and scaffolding to deepen the learning and problem-solving skills of students. There are opportunities to explore various methods for solving a problem, and AI-powered learning tools can offer similar assistance with step-by-step guidance, instant feedback, and explanations. AI, however, should support, not supplant, students' independent thinking and analysis in learning.

Additionally, the findings underscore the significance of learning motivation in the context of AI-assisted learning and problem-solving skills. This is in line with Namaziandost et al., (2026) who placed emphasis on the importance of motivation in supporting engagement,

persistence, and effective learning. Moreover, motivated learners tend to be more active in learning activities, self-regulate their learning activities and persevere with difficulties. Higher learning motivation students might then be more willing to try out AI generated explanations, to check information and to use the knowledge gained to solve academic problems. However, learners with lower motivation might rely on AI to find immediate answers, reducing the chances for acquiring independent problem-solving abilities.

Based on the moderation finding, it can be concluded that students' problem-solving skills are strengthened by the positive relationship between the use of AI learning and learning motivation. This is similar to the interpretation of Tutal (2026) that students' expectations, values, and motivational beliefs affect their learning choices and persistence. In the same way, Arwadi et al., (2026) stated that the conceptualization of active cognitive involvement is important in engendering meaningful problem-solving skills. This view implies that it is not sufficient to have access to AI tools to achieve a more positive learning experience—motivation in students to engage in meaningful interactions with AI tools is also crucial. Hence, HEIs should promote the conscious use of AI, thinking and active involvement in problem-based learning. These practices can support students as they employ AI as a tool for learning, while maintaining their own analytical and problem-solving skills (Aslam, 2026).

Conclusion

The findings suggest that AI-assisted learning is positively associated with students' problem-solving skills in higher education, indicating that the use of AI-based learning tools may help students develop better approaches to identifying problems and finding suitable solutions. The use of AI in education can be beneficial in terms of understanding complex topics, brainstorming solutions, providing immediate feedback, and tackling academic challenges in a more effective manner. The results suggest that AI-supported learning could be a useful educational tool in an active and reflective manner. The effectiveness of its use, however, relies on how students interact with the AI tools and how they use the information gained to support their learning processes.

The study also underlines the moderating role of learning motivation in the relationship between AI-assisted learning and problem-solving skills of students. AI-generated explanations could be more likely to engage students with high motivation, help them persevere with learning challenges, and foster independent reasoning skills. Hence, it is recommended that educators and higher education institutions foster the use of artificial intelligence in the educational environment that is motivated, responsible and purposeful. Using AI-enriched learning and fostering critical thinking and active learning participation could enhance students' problem-solving abilities and overall learning experiences.

Future Implications

Future research should examine the impact of AI-supported learning on students' problem-solving skills across different educational levels, academic subjects, and learning environments. Researchers could also explore other factors that may influence how students use AI tools to solve problems and develop independent learning skills. Longitudinal or experimental research designs can be employed to study the long-term effects of continuous use of AI on students' critical thinking, independent study, and problem-solving skills. Future research might involve examining other factors including digital literacy, academic self-efficacy, learning engagement, to gain better insights in the area of AI-supported learning outcomes. Furthermore, more extensive and varied samples and comparisons of AI tools can support in determining educational practices that enhance learners' learning drive and problem-solving skills.

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