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The Psychology of Human–AI Collaboration: Understanding Student Learning in Intelligent Educational Environments

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ABSTRACT

Artificial Intelligence (AI) has transformed educational practices by creating intelligent learning environments that support personalized instruction and enhance student learning. This article looks at the psychology dimensions of human and AI collaboration, and how this collaboration alters student learning, focusing on the influence of trust, motivation and self-regulated learning. A quantitative cross-sectional design of the study was adopted, and an online survey was administered with a targeted sample of 367 students from public and private sector higher education institutions of Punjab and Sindh, Pakistan, such as, University of the Punjab, Bahauddin Zakariya University, Government College University Faisalabad, University of Karachi, NED University of Engineering and Technology and Sukkur IBA University. The survey was administered online via Google Forms, and the sampling was done through the mailing lists of the universities, as well as other social media. The gathered data was cleaned using Microsoft Excel and analyzed with the help of SPSS Version 27, applying descriptive statistics, Pearson correlation, and some other statistical methods such as, multiple linear regression, independent samples t-test, and one-way ANOVA. It was found that student learning was positively impacted by human–AI collaboration while trust, motivation, and self-regulated learning positively impacted learning outcomes. This study serves as a foundation for designing AI-integrated learning technologies by educators and administrators, with a special focus on the psychological aspects, to establish effective, learner-friendly and sustainable intelligent learning systems.

Introduction

The evolution of AI has changed modern education by integrating new systems into teaching, learning, and assessing students, as well as aiding critical decisions. Human-AI collaboration describes the partnership between students and AI-based systems. This collaboration merges human cognitive potential with the flexible and responsive nature of advanced systems. This partnership aims to meet specific educational needs. Unlike traditional educational technologies that serve mostly as information repositories, AI-based educational systems include learning processes through the provision of customized learning, flexible and responsive assessments, AI-based tutoring, and automated feedback with real-time learning supports. According to Luckin et al. (2016), by placing learners at the center of the learning process, educational AI systems can customize the learning process to the individual learner and, as such, improve the overall quality and accessibility of education.

Intelligent learning systems have made teaching and learning systems more collaborative and personalized, as opposed to the traditional teaching-centered approach. AI-based systems such as intelligent tutoring systems, virtual learning assistants, adaptive learning systems, and generative AI tools provide students with continuous learning assistance, as well as instant, customized learning and and feedback. These systems promote cognitive skills and critical thinking through various interactions. Based on the findings of Holmes et al. (2022), human-AI collaboration improves education by providing students and teachers with the means to design dynamic and optimal learning systems. Zawacki-Richter et al. (2019) claimed that through the use of AI tools, learning paths and teaching methods based on evidence improve learner activity and academic achievements.

AI is changing how we teach and learn globally. Now, we need to understand the psychology behind how people will work with AI. Factors like trust, motivation, and the ability to manage oneself, will help us understand if students are ready to work with AI. Schools are going to have to invest to incorporate AI into the school system in a way that helps students instead of filling a void and taking jobs. Ouyang and Jiao (2021) suggest that the AI used in classrooms of the future will help students learn how to think and be creative while allowing teachers to work. For this reason, it is important to understand the psychology of people and AI to create classrooms where students can learn in a sustainable way and become successful.

Psychological Foundations of Student Learning in AI-Supported Environments

There are many components to the psychology of a student, like motivation, self-control, and thinking. AI is creating new ways to help students learn and bring new tools into the classroom that are smart and adaptive. AI classrooms help teachers by monitoring how students learn and creating new ways to help students learn and bringing new tools into the classroom that are smart and adaptive. According to Atchley, P et al. (2024) AI classrooms help students learn how to control their own learning and give them the tools and the help to learn how to be more involved with their learning.

The impact of AI on education is revolutionary because students can now use tools that give instant feedback, provide and adjust tests, along with AI-based tools that provide guidance for efficient learning. Most standard based instructional methods are now obsolete, as most AI companies have created programs that modify learning materials based on individual assessment, as well as students' cognitive levels, and can be used by students at their own pace. AI-based instructional tools also promote learning, as students develop greater confidence, and learn to articulate and rationalize the answer to problems. They also learn to answer problems confidently. Azevedo and Gašević (2019) noted that self-regulated learning is enhanced when students are aided by learning technologies that help them to learn, as they have a better perspective on their learning goals, and as a result, their academic performance along with their understanding of the concepts improves.

Human–AI Interaction and Student Engagement

In education, one of the major factors that influences the success of human–AI collaboration is the way learners interact with advanced intelligent educational systems. AI technologies in the form of intelligent tutoring systems, virtual assistants, and adaptive learning systems create interactive learning environments by offering tailored suggestions and real-time feedback and support on a continuous basis. These systems enable students to participate in learning activities, enhance their confidence, and improve their overall engagement. Dang, B et al. (2025) observed that students are inclined to use educational content mediated by AI technologies and that they are likely to achieve improved educational outcomes when they view the AI technologies as useful, reliable, and supportive.

Engaging students behaviorally, emotionally, and cognitively is fostered by adaptive instructional technology and responsive human–AI interaction. AI systems that track students' progress in learning, identify learning gaps, and suggest improvements are likely to support students' willingness to learn and to take the initiative to learn. According to Holmes et al. (2022) when students' learning is supported by AI personalization, it creates positive learning experiences that fosters a greater desire to learn and a greater willingness to engage in learning activities. Subsequently, students take on a greater role in learning and developing critical thinking and problem-solving skills.

Self-Regulated Learning and Cognitive Development in Intelligent Educational Environments

Self-regulated learning (SRL) is an important psychological construct that correlates positively with the academic achievement of students. The education-related applications of AI have significantly improved the manifestation of SRL in intelligent educational systems. Self-regulated learning is described as the ability of a learner to plan, monitor, control, and evaluate their own learning process in the pursuit of a specific academic goal. Academic technologies that incorporate AI facilitate this process by creating personalized learning experiences, providing immediate feedback and illustrating the learner's progress, and offering adaptive learning interventions to assist students in articulating learning goals. Chiu, T. K., &

Rospigliosi, P (2025) posit that intelligent educational systems further promote students' self-regulation through the encouragement of continuous monitoring, reflection, and decision-making during the learning process.

AI learning systems help build students' cognitive skills by offering customized, immersive learning that helps students understand learning at a deeper level. Holistic learning systems and AI learning frameworks help students solve multifaceted challenges and engage them in higher-level cognitive processes. Hutson, J., & Plate, (2023) advanced the idea that AI learning technologies prompt substantial learning by making learning materials flexible at the cognitive level of students and supporting students academically using a cognitive flexible learning framework. Accordingly, students can learn more efficiently and retain the information longer as a result of the adaptive model learning technologies.

Research Objectives

- To examine the influence of human–AI collaboration on student learning in intelligent educational environments.
- To investigate the relationship between psychological factors (such as trust, motivation, and self-regulated learning) and students' engagement with AI-assisted educational technologies.
- To assess the impact of human–AI collaboration on students' academic performance and learning outcomes in intelligent educational environments.

Research Questions

- How does human–AI collaboration influence student learning in intelligent educational environments?
- What is the relationship between psychological factors (such as trust, motivation, and self-regulated learning) and students' engagement with AI-assisted educational technologies?
- What is the impact of human–AI collaboration on students' academic performance and learning outcomes in intelligent educational environments?

Problem Statement

The use of Artificial Intelligence (AI) in smart educational environments has rapidly changed how learners experience educational content and how they use instructional technologies. While AI-based systems have great potential for building personalized learning, providing adaptive feedback, and promoting learners' academic success, little is known about the psychological factors that influence productive human–AI collaboration in education. It is likely that students' trust in AI, learning motivation, self-regulated learning, and the degree to which students are engaged in learning will influence whether AI develops either meaningful learning or an overreliance on the technology that ultimately diminishes students' critical thinking. To date, the majority of research has focused on the technological capabilities of AI, at the expense of the psychological factors that influence students' use of advanced learning technologies. This is especially true in higher education, where the use of AI has rapidly advanced beyond the research available on the consequences for students' learning. This study aims to investigate the psychology of human–AI collaboration by exploring the impact of psychological factors on students' learning, engagement, and academic performance within smart educational environments. The findings of this study will inform the appropriate use of AI in educational settings.

Significance of the Study

This study aims to expand knowledge regarding human–AI collaboration. Specifically, this study examines the impact of intelligent educational environments on student learning, engagement, and performance within the context of the collaboration. With Artificial Intelligence becoming widely available and adopted by learning institutions, the integration of human psychology becomes critical to understanding and informing the design and implementation of AI-enhanced learning environments. The outcomes of the study will yield insights to educational practitioners, curriculum and educational policy designers and framers, and educational administrators on the potential of learning-centered, intelligent educational systems to foster motivation, engagement, trust, self-regulation, and constructive, meaningful learning. The study will also contribute to the construction of intelligent educational systems by educational psychologists to foster positive learning outcomes. Finally, the study will offer developers of educational technology systems advances in cognitive psychology designing educational systems to incorporate AI for positive learning outcomes. On the other hand, there is no evidence of the collaboration of educational psychology and artificial intelligence within an ethical and sustainable framework. This gap will be closed by research addressing ethical and sustainable intelligent educational environments (IEE) by offering empirically grounded first steps to guide future research in human–AI collaboration.

Literature Review

Human–AI collaboration has been one of the major developments in today's education. We are witnessing the partnership of human learners and smart technologies that augment the processes of teaching and learning. Traditional educational technologies allow students to access digital learning resources. On the other hand, Artificial Intelligence (AI) collaborates with learners by providing personalized learning, adaptive feedback, automated grading, and contextual learning suggestions. Mishra, M., et al. (2025) argue that AI should be an educational partner, and should be seen as a complimentary addition to human intelligence. AI partners support learners in acquiring knowledge, critical thinking, and problem-solving. Similarly, it has been argued by Järvelä, S et al. (2023) that the intelligent educational environments, through the ongoing, real-time evaluation of students' learning progress and academic activities, facilitate pedagogical processes that are more personalized and more learner-centered. These environments contain an array of different technologies (i.e. intelligent tutoring systems, conversational agents, virtual assistants, and learning analytics) and provide interactive educational processes that adapt and respond to learners' cognitive and emotional needs. As more educational institutions embrace AI-based systems, human–AI collaboration is necessary in order to enhance the quality of teaching, as well as to cultivate significant learning experiences.

The application of intelligent educational environments involves the design of dynamic systems where artificial systems are in constant engagement with learners during the course of learning. Examples of systems in the context of education include intelligent tutoring systems that help learners by identifying misconceptions based on student responses. Such systems adapt learning materials to the level of the learners. Automated recommendation systems evaluate learner responses and structures to suggest learning activities and resources to learners that are likely to enhance learning. According to Ouyang and Jiao, intelligent educational environments promote learning by providing immediate feedback to learners. Learning environments that are intelligent encourage learners to actively engage in the learning process. In such environments, artificial systems serve the purpose of learning companions Wu, R et al., (2024).

Psychological Factors Influencing Human–AI Collaboration: Trust, Motivation, and Self-Regulated Learning

Human and AI collaboration systems within an intelligent educational environment have both positive and negative impacts on educational outcomes, and much of this depends on the psychological factors that determine how students interact with AI learning systems. The greatest impact on the willingness of students to use AI learning systems are self-regulated learning and motivation. Trust has the greatest impact on the educational experience of learners. Davis (1989) stated that learners' perceptions of a system's usefulness and ease of use are the main factors that drive the continuous adoption of a system. Venkatesh et al. (2003) stated that the behavioral intentions of learners to use educational systems are factors of cognitive perceptions, a social system, and the conditions that are present. AI learning systems are expected to offer users a high level of personalization, as well as the ability to provide learning and assessment that is tailored to the users' needs. However, the technology must be complemented with a high degree of psychological preparedness on the part of learners to interact with the system. The psychological factors determining trust, motivation, and self-regulated learning have become of significant value as AI systems continue to permeate the teaching and learning systems of higher education.

One of the prominent psychological factors that affect the success of human–AI collaboration is trust. In the context of education, trust refers to the confidence of students that AI systems are reliable, accurate, and sufficiently transparent to help in the facilitation of constructive, meaningful learning. Mayer et al. (1995) say that trust is formed when individuals see that the other party is competent, reliable, and acts in their best interests. Although their model was developed to look at trust in the interpersonal sense, other scholars have been able to extend these ideas to construct trust in AI. Glikson and Woolley (2020) argue that trust in AI allows individuals to defer to intelligent systems, while retaining the appropriate degree of human judgment and decision-making. In the case of the intelligent educational systems, students who trust AI explanations and assessments are likely to interact more with AI-powered educational systems and are more likely to adjust their learning strategies based on AI recommendations. On the contrary, a low degree of trust in AI systems results in a more skeptical stance toward the use of AI in education and limits the potential of intelligent systems. Thus the main goal for educational technology developers and AI-enabled learning systems is the creation of trustworthy AI.

Student Engagement with AI-Assisted Educational Technologies

Engagement is a critical aspect of learning. Persistence, motivation, and even learning outcomes are all affected by how engaged a student is. The latest technologies in the classroom, particularly those that incorporate Artificial Intelligence, have created more modern, engaging ways for teachers to create learning activities for their students. These technologies offer students a more interactive, adaptable, and individualized learning experiences. More engaged students tend to be more successful students. The term student engagement was actually developed to measure how cognitively, emotionally, and behaviorally students are invested in the activities that create the potential for learning. Fredricks et al.'s (2004)

conceptualization of student engagement breaks the term down further into behavioral, emotional, and cognitive student engagement. Behavioral engagement, in this context, denotes a student's participation in a learning activity. Emotional engagement is a student's interest, enjoyment, and sense of classroom belonging. Cognitive engagement, the final aspect of the conceptualization, is measured by the depth of learning and critical thinking that a student is willing to invest in a given activity. AI-enabled learning technologies personalize the learning experience through differentiated instruction, feedback, and intelligent, adaptable learning tools that encourage students to engage continuously in the learning process. The rapid adoption of AI tools in modern classrooms has made the study of the effects of AI on student engagement a priority for educators (Peng, Z., & Wan, 2025).

Unquestionably, the potential of AI in education is enormous. AI systems are built to cater to students' personal preferences, capabilities, and progress. They engage students by providing personalized tutorials. Unlike traditional systems, which offer the same set of instructional materials to all students, AI systems identify students' preferred learning styles. They can even identify students' strengths and weaknesses. They can modify tutorials to help students learn better and faster. Jafari, E. (2024), claim that students are provided learning materials that they can relate to and are therefore able to easily and deeply engage in learning. These intelligent systems also provide students with immediate feedback and formulated instructional suggestions. This iterative system allows students to learn and interact with the instructional system, as learning is no longer a one-way process. Mansur, S (2025) also claim that engagement in learning increases when students are provided systems that require them to interact and learn. Furthermore, AI educational systems are blended with virtual systems that answer students' questions, meaning that learning is no longer confined to the classroom. Students can learn and be engaged outside the classroom, as they can receive help at any time.

Impact of Human–AI Collaboration on Student Learning and Academic Performance

Intelligent Educational Systems have been transformed by integrating Human – AI collaboration to the point that they have influenced Student Learning and Academic Performance by providing flexible, customized, and analytics-driven solutions. Human – AI collaboration is the relationship that occurs when Students use the Analytical Strengths of Artificial Intelligence, while simultaneously using Human Intelligence, Creativity, and Critical Thinking to achieve learning outcomes. AI does not take away from traditional pedagogy, but complements Teaching by providing Student-Focused Feedback, Tracking the Progress of Learning, and Analyzing Students' Academic Performance. Per Järvelä, S et al. (2023), the presence of AI in Education positions Teaching and Learning in a true time sense and enables Teaching to be more individualized. This was further supported by Alyoussef, I et al. (2025), where Adaptively Designed Learning Technologies amplify Teaching and Learning by being aligned to the cognitive level of the Learning Population and thus contribute to performance and learning outcome levels. With the proliferation of Intelligent Learning Systems, analyzing their impact on Student Learning is a fundamental aspect of educational science in the domain of instructional design.

Combining AI with human resources is a good approach to helping tailor learning activities to meet students' unique learning styles, levels of ability, and developmental needs. Traditional teaching methods rely on a 'one size fits all' approach, which may be inadequate to serve varying learning needs. Conversely, AI-Mediated education systems monitor learners' performances in real-time, locate their knowledge gaps, and create instructional materials that help learners maximize their learning. As Dhanasekaran, R. (2025) explain, learning environments that employ adaptive systems offer learners the ability to receive customized instructional pathways, automated feedback, and learning scaffolds that empower learners to continue their learning at their preferred pace. Similarly, Cichocki, A., & Kuleshov. (2021) argued that systems of intelligent tutoring support the development of learners' understanding of concepts by providing instant feedback, engaging learners with tasks that require active participation, and ongoing support of a learning nature. These features of adaptive systems aid learners in engaging in deep learning and foster an ability to self-generate knowledge.

Research Gap

Most of the studies that have focused on the employment of Artificial Intelligence (AI) in education have focused on the technologies, the employability of AI, and the effectiveness of AI for the enhancement of teaching efficiency and personalized learning. Existing studies have focused separately on different phenomena of student engagement, trust, motivation, self-regulated learning, and the like. However, these phenomena have been viewed predominantly as separate constructs. Very few empirical studies have focused on human–AI collaboration and its impact on student learning and performance in the AI assisted educational setting, especially from the perspective of educational psychology. Most of the studies that have been published have been done in the developed, technologically advanced countries. There is a dearth of studies in the developing educational systems, in which the use of AI is rapidly growing as out of the developed countries, but is largely uninvestigated and unexplored. There is an urgent need for research in the developing educational systems that focuses on the collaboration of human and AI systems and the integration of the components of trust, motivation, and self-regulated learning, and the

impact these components have on student learning and academic performance. This study intends to provide an integrated framework in developing educational systems, focusing on the cited psychological components, thereby addressing the gap in educational psychology and the field of artificial intelligence.

Research Hypotheses

H1: There is a significant positive relationship between human–AI collaboration and student learning in intelligent educational environments.

H2: Trust, motivation, and self-regulated learning significantly predict student learning in intelligent educational environments.

H3: There is a significant difference in student learning through human–AI collaboration between male and female students.

H4: There is a significant difference in student learning through human–AI collaboration among students belonging to different academic year (or age) groups in intelligent educational environments.

Conceptual framework

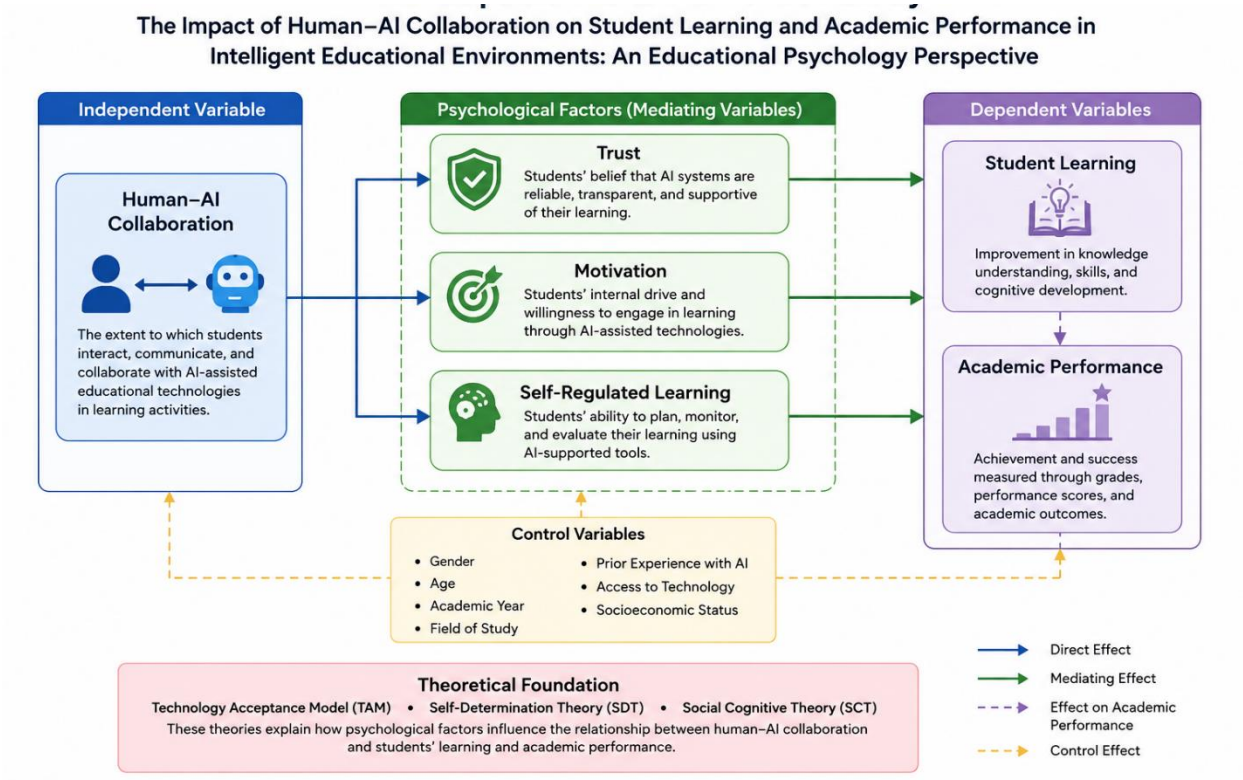

Figure 1.1 Conceptual framework

Methodology

Research Design

This study employed a quantitative, cross-sectional survey research design. This approach was appropriate for this study as quantitative research is useful to objectively explore relationships among the study variables, and a survey is a common approach for data collection. A survey instrument can be structured to yield specific types of data, including quantitative data. The cross-sectional design was also appropriate for this study as data were collected from participants at one specific point in time, and this design allowed the researcher to explore the human–AI collaboration likely to influence student learning and student performance within intelligent educational systems. The study adopted a questionnaire that was previously validated. This measure was used to ensure the reliability and validity of the instrument

Population

The participants of this study comprised the undergraduate and postgraduate students of the public and private higher educational institutions of the provinces of Punjab and Sindh of Pakistan. This study focused on these students because of their prominent use of some of the prominent AI-assisted educational tools, including ChatGPT, Google Gemini, Microsoft Copilot, Grammarly, Intelligent Tutoring Systems, Adaptive Learning Platforms, and other AI-based educational apps, during their studies. The geographical scope of this study comprised the following universities in Punjab: University of the Punjab (Lahore), Bahauddin Zakariya University (Multan), University of Education (Lahore), Government College University Faisalabad, Islamia University of Bahawalpur, University of Sargodha, University of Gujrat, University of Central Punjab (Lahore), COMSATS University Islamabad (Lahore Campus), and University of Management and Technology (Lahore). As for Sindh Province, the universities selected were University of Karachi, NED University of Engineering and Technology, Mehran University of Engineering and Technology, Shah Abdul Latif University Khairpur, Sukkur IBA University, Liaquat University of Medical and Health Sciences and Institute of Business Administration (IBA) Karachi. These universities were selected because they cover numerous disciplines and have adopted AI-based digital learning tools.

Target Audience

The target audience comprised students at the undergraduate, graduate, and postgraduate levels at public and private universities in Punjab and Sindh, Pakistan. Selected respondents came from a variety of disciplines, including education, social sciences, business administration, computer science, engineering, health sciences, and management and information technology. Only those participants who had prior experience using AI-assisted educational technologies for learning, assignments, research, examinations, and/or other forms of academic assistance were eligible to take part in the study. The participants included both male and female students, and all age groups and academic levels, to ensure that the study covered the comprehensive segment of university students in regard to participation in intelligent educational environments.

Sampling Technique

A non-probability convenience sampling technique was used for the purpose of this study. This sampling technique was used to gain access to respondents who were easily available and who used AI-assisted educational technologies. Convenience sampling was widely used in educational and behavioral research. A lot of studies used such sampling methods because preset inclusion criteria were easily met, facilitating efficient data collection. Thus, the researcher used this method in educational technology research to survey the population of students who voluntarily participated in the study and who experienced AI-enabled educational technologies. This sampling method also provided the researcher with adequate data in a timely manner and with limited resources, while ensuring that participants had experience and knowledge about the study variables and the research.

Sample Size

367 respondents from public and private universities throughout Punjab and Sindh, Pakistan, constituted the sample size. It was determined that for the type of quantitative statistical analysis that would be involved (e.g. correlations, multiple linear regressions, independent samples t-tests, one-way ANOVA), the selected sample size was adequate as it captured high statistical power. Respondents possessed a variety of demographic features, including gender, age, academic year, field and area of study, and level and background of education, which added depth to the data that was collected.

Data Collection

Data were gathered via a structured questionnaire. The items were derived from validated tools in existing literature. Human-AI Collaboration was measured using questionnaire items based on Long and Magerko (2020) and Chiu (2022) and was concerned with students' interactions, cooperation, and engagement with AI-assisted educational technologies. Trust was assessed using a modified version of the Cukurova, M. (2025) trust scale, which asks about students' trust in the reliability, transparency, and usefulness of AI systems. Regarding Motivation, tendencies were measured via Deci and Ryan's (2000) Self-Determination Theory, in which the educational motivation scale developed by and validated in Lin, H., & Chen (2024) was incorporated. Self-Regulated Learning was assessed using the scale designed by Zimmerman (2002), with supportive evidence from Lyu, C et al., (2026). The assessment was concerned with students' planning, monitoring, and evaluation of learning. Student Learning and Academic Performance were assessed using modified versions of the scales presented in Li, H et al. (2025). The focus of these scales was learning, engagement, knowledge, and learning, whereas achievement was concerned with perceived academic performance. All questionnaire items were measured via a five-point Likert scale with the following anchors: 1 = Strongly Disagree and 5 = Strongly Agree.

The survey was made with Google forms, and the survey link was sent in university email groups, WhatsApp, Facebook, LinkedIn, and other academic communication resources. The online survey was sent to students of all public and private universities in Punjab and Sindh. Respondents were made aware of the study and the voluntary nature of their participation. The completed forms were automatically collected in Google Forms and exported for analysis.

Ethical Considerations

To protect participants, consideration of the ethics of research was essential. The nature of the research was made clear to participants, and their involvement was voluntary. The online survey began with a request for informed consent. Participants were told about the anonymity of their survey responses, that the survey would be for a research project, and that no personal, identifying information would be included. Participants were free to exit the survey and refuse to answer any questions without consequence. Participants and their responses were made to be as anonymous, and the completed surveys were collected in a way to be as secure and to protect the integrity and ethics of the research.

Data Analysis

After data collection, responses were exported from Google Forms and were first screened, coded, cleaned, and checked for accuracy in Microsoft Excel. The cleaned dataset was then analyzed using the Statistical Package for the Social Sciences (SPSS) Version 27. The demographic data and study variables were summarized and described using quantitative measures of central tendency (mean) and dispersion (standard deviation), along with basic frequency distributions and percentages. The relationship between Human–AI Collaboration and Student Learning was investigated using a Pearson correlation. The effects of Trust, Motivation, and Self-Regulated Learning on Student Learning were investigated using a multiple linear regression, while independent samples t-test and one-way analysis of variance (ANOVA) were used to analyze the differences in Student Learning between males and females and across the academic year and age groups, respectively. These statistical analyses added significant value to the study.

Table 1: Demographic Profile of the Respondents (N = 367)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	189	51.5
	Female	178	48.5
	Total	367	100.0
Age	18–20 Years	86	23.4
	21–23 Years	158	43.1
	24–26 Years	87	23.7
	Above 26 Years	36	9.8
	Total	367	100.0
Academic Year	1st Year	71	19.3
	2nd Year	95	25.9
	3rd Year	82	22.3
	4th Year	74	20.2
	Postgraduate	45	12.3
	Total	367	100.0
Type of University	Public University	219	59.7
	Private University	148	40.3
	Total	367	100.0
Field of Study	Education	61	16.6
	Business & Management	78	21.3
	Computer Science & IT	73	19.9
	Social Sciences	64	17.4
	Engineering	49	13.4
	Health Sciences	42	11.4
	Total	367	100.0

Presents the demographic profile of the 367 respondents included in the study. The distributions show the sample covered most demographic representations of university students. Slightly more than half of the respondents (51.5%) were male,

while the remaining respondents were female (48.5%). The highest percentage of participants was in the age range of 21 – 23 years, followed by the age brackets of 24 – 26 years (23.7%) and 18 – 20 years (23.4%). The participants also indicated their academic year and showed high level participation of students in the 2nd and 3rd years. The study also found that a high number of participants belonged to public universities (59.7%) when compared to those in private universities (40.3%). Respondents also indicated their academic field. The highest group was in Business and Management (21.3%), while the other participants were in Computer Science and IT (19.9%), Social Sciences (17.4%), Education (16.6%), Engineering (13.4%), and Health Sciences (11.4%). The demographic distribution shows that the study covered a wide range of participants, and offered extensive coverage of the field to engage and analyze the collaboration of humans and AI in advanced educational spaces.

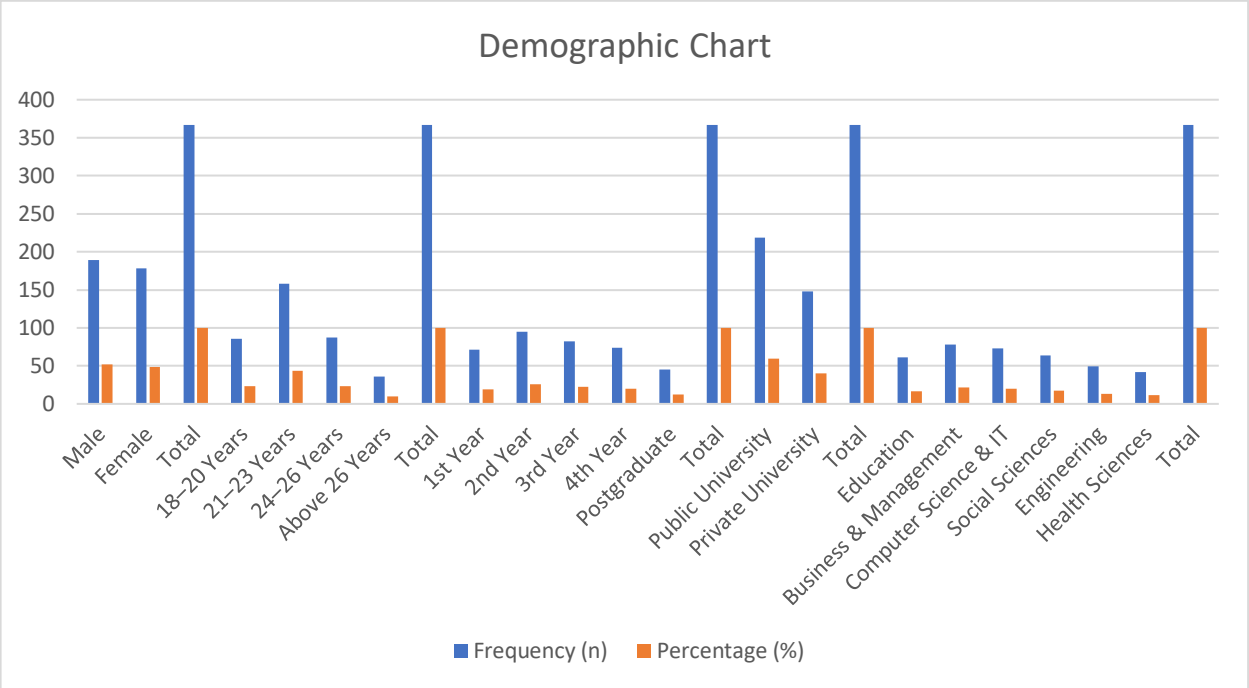

Figure 2 Demographic Profile of the Respondents (N = 367)

Table 2: Pearson Correlation Analysis between Human–AI Collaboration and Student Learning (N = 367)

Variables	Mean	Std. Deviation	1	2
1. Human–AI Collaboration	3.87	0.61	1	
2. Student Learning	3.94	0.58	0.712**	1

Pearson correlation was used to know how Human–AI Collaboration and Student Learning related to the sample of 367 respondents. A strong positive relationship was found between the two variables, and the relationship was statistically significant ($r = 0.712$, $p < .001$). The result suggests that the higher the Human–AI Collaboration observed in the intelligent educational environments, the more Student Learning will be. A positive relationship suggests that students who engaged in Human–AI Collaboration and used AI-augmented educational technologies reported improved learning experiences, enhanced knowledge and learning, and increased academic involvement. Since the significance value was < 0.01, the relationship was said to be significant, and it was confirmed that there was a positive relationship between Human–AI Collaboration and Student Learning among the university students.

Table 3: Multiple Linear Regression Analysis Predicting Student Learning (N = 367)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.814	0.663	0.660	0.342

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	84.721	3	28.240	237.864	.000

Residual	43.088	363	0.119
Total	127.809	366	

Coefficients

Predictor Variables	Unstandardized B	Std. Error	Standardized Beta	t	Sig.
(Constant)	0.654	0.179	—	3.654	.000
Trust	0.321	0.048	0.346	6.688	.000
Motivation	0.287	0.046	0.309	6.239	.000
Self-Regulated Learning	0.354	0.051	0.372	6.941	.000

Multiple linear regression was used to analyze the effects of Trust, Motivation, and Self-Regulated Learning on Student Learning for the 367 respondents. The regression model produced a strong correlation ($R = 0.814$) and accounted for 66.3% of the variance in Student Learning ($R^2 = 0.663$, Adjusted $R^2 = 0.660$). The regression model was also supported by ANOVA, which yielded ($F = 237.864$, $p < .001$). These results imply that the variables of this study were able to, to a large extent, explain the variance in Student Learning. The results of the coefficient analysis showed Trust ($\beta = 0.346$, $p < .001$), Motivation ($\beta = 0.309$, $p < .001$), and Self-Regulated Learning ($\beta = 0.372$, $p < .001$) positively and significantly affected Student Learning. Self-Regulated Learning, Trust, and Motivation were the factors identified as most to least likely to affect Student Learning, respectively. The analysis indicates that having students build Trust in AI Technologies and Strengthening Learning Motivation and Self-Regulated Learning improves Student Learning in Intelligent Educational Learning Environments.

Table 4: Independent Samples t-Test for Student Learning by Gender (N = 367)

Group Statistics

Gender	N	Mean	Std. Deviation	Std. Error Mean
Male	189	3.98	0.56	0.041
Female	178	3.84	0.59	0.044

Independent Samples t-Test

Variable	Levene's Test (Sig.)	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval
Student Learning	0.318	2.347	365	0.019	0.140	0.060	0.023 – 0.257

Table 5: One-Way ANOVA for Student Learning across Academic Year Groups (N = 367)

Descriptive Statistics

Academic Year	N	Mean	Std. Deviation
1st Year	71	3.72	0.58
2nd Year	95	3.84	0.55
3rd Year	82	3.95	0.57
4th Year	74	4.08	0.53
Postgraduate	45	4.16	0.51
Total	367	3.94	0.58

One-Way ANOVA

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.467	4	2.117	6.821	.000
Within Groups	112.394	362	0.310		
Total	120.861	366			

To see the variation in Student Learning across student groups of differing academic years, a one-way ANOVA was performed. Postgraduate students had the highest mean score (M = 4.16, SD = 0.51). The mean scores were lower for fourth year (M = 4.08, SD = 0.53), third year (M = 3.95, SD = 0.57), second year (M = 3.84, SD = 0.55), and first year students (M = 3.72, SD = 0.58), respectively. ANOVA was significant and revealed a difference among the academic year groups ($F(4, 362) = 6.821$, $p < .001$). Then, Student Learning was shown to vary based on the academic year. From the results, the students that were in the higher years of study were shown to have a higher level of learning in AI-assisted learning environments. Additionally, higher year students have a higher level of comfort with learning technologies and educational technologies.

Discussion

The study's goal was to analyze the psychology involved in human–AI collaboration and how it shapes students' experiences and activities in intelligent educational environments. More specifically, the study aimed with regard to human–AI collaboration and student learning to answer the following questions: how do trust, motivation, and self-regulated learning influence student learning, and what are the differences in the learning outcomes in relation to demographic variables? The findings assert that human–AI collaboration significantly enriches the students' learning activities in the AI-oriented educational environments. It can also be said that students who work with AI-oriented educational technologies achieve better learning, are more academically engaged, and benefit from education more. These findings are evidence to support that it is becoming increasingly important in education to consider AI as a collaborative educational partner. When it comes to the intelligent educational systems of the future, their efficacy will depend not only on the further development of technology, but also on the students' psychological readiness to collaborate with AI systems in a meaningful and effective way.

The correlation analysis indicated that students who interacted more productively with AI educational technologies demonstrated a higher level of learning. As such, the analysis showed a strong positive relationship between human–AI collaboration and student learning. There is more literature to support the findings. For instance, adaptive AI educational systems assist instructional staff and aid learning by enhancing cognitive skills and adapting to the student's level of academic achievement. Troussas, C et al. (2025) stated that AI systems make it possible to provide individualized systems of instruction. This supports the theory of Molenaar, I. (2024), which stated that intelligent educational systems provide the means for promoting individualized systems of instruction and, consequently, assist the academic progress of the student. Moreover, Holmes et al. (2022) argued that instructional technologies make learner-centered education more effective, because they make it possible to adapt instructional content to the different learning needs of students, as well as to their individual learning progress. The findings thus also support previous empirical research, which demonstrated that significant educational improvements are associated with the collaboration of students with instructional technologies.

Analysis of multiple linear regression showed that trust, motivation, and self-regulated learning predicted student learning, with self-regulated learning being the strongest of the psychological variables. These findings suggest that the potential of AI-based education hinges on the intelligent technologies, and the psychological characteristics of the learners. Students who trust the AI system are more likely to accept the AI's suggestions and use them to modify their learning. In the same manner, students who are more self-regulated are likely to use the AI learning system to control and enhance their learning. Motivated students are more involved with the AI learning system. These findings are in support of the work of Deci and Ryan (2000) in that students who are motivated are likely to achieve higher levels of learning when the educational system meets their psychological needs. The work of Niemi, H. (2021) is also supported in that self-regulated students obtain better learning results because of their proactive involvement with the control and assessment of the learning process. In addition, Molenaar, I (2024) argued that AI-based learning environments significantly enhance students' motivation and engagement by providing tailored learning experiences. These studies validate the findings of this research, that psychological construct is the most important factor in the utilization of AI technology in learning.

The t-test indicated that learning scores for males were higher than scores for females, thus showing a statistically significant difference. Despite this difference, both groups were found to benefit from the AI educational technology. This could potentially be the result of the difference in males' and females' exposure digitally, confidence in the use of technology, the prior use of AI, and patterns in the usage of technology amongst college students. Previous studies have shown differing results for the effect of gender on the adoption of educational technology. Agboola, O, et al. (2025) indicated that the role of gender on the adoption of technology is through the difference in the perception of the usefulness and ease of technology, although, in more recent research, the adoption gap is closing with the availability of digital technology. Kim, J (2024) noted that, in order to provide the students of all genders the opportunity to interact with the AI-assisted learning systems, educational institutions need to provide students the learning opportunities that utilize AI. Thus, the differences in gender that this study revealed, actually show the differences in the use of technology in education, support for learners, and digital literacy and should not be viewed as unchanging characteristics of the learner.

One-way ANOVA demonstrated notable variances of learning among students of different academic years. It was found that seniors and postgraduate students learned more than first- and second-year students. This indicates that as students progress through their studies, they may improve their ability to engage with AI-based educational learning technologies. The students in higher academic years are presumably more digitally literate, more confident in their studies, and are engaged with educational technologies to assist them in learning, conducting research, and completing tasks and activities. Therefore, they have greater capability to engage with the use of AI technologies than students who have just entered the higher education system. Ouyang and Jiao (2021) found similar methods and reported that students' engagement with AI technologies progresses as their contact with educational adaptive learning technologies and digital resources develops. Similarly, Yan, L et al. (2024) emphasized that learners' engagement with AI technologies in educational environments leads to improved learning outcomes. The current findings are in alignment with the previous studies that have reported that the positive effect of academic engagement on successful collaboration with AI exists. The present findings are in favorable agreement with existing theories, including the Technology Acceptance Model, Self Determination Theory and Social Cognitive Theory.

Conclusion

This article presents research on human-AI collaboration in intelligent educational environments and its effect on student learning. The results indicated that human-AI collaboration improves student learning through the construction of educational tools that are personalized, adaptive, and interactive. Psychological constructs of the user, such as trust, motivation, and self-regulated learning, were shown to positively affect learning outcomes in the context of AI-based educational technologies. The relationship between human-AI collaboration and student learning was shown to be significantly positive based on the results of the statistical analysis. In addition, trust, motivation, and self-regulated learning were identified as significant predictors of student learning outcomes. Furthermore, differences in student learning were found based on both gender and academic year, which indicates that demographic characteristics affect the interaction of students with AI-based educational systems. The findings of the study suggest that the combined use of AI technologies and effective collaboration of students can significantly enhance educational experiences and the level of achievement in learning in the higher education sector.

To summarize, the findings show that a key determinant of the successful application of Artificial Intelligence to the education sector is the capability of learners to interact with these advanced systems. While the role of technology in bringing about this transformation is pivotal, equally important are the learners' readiness and the potential psychological impacts of engaging them with AI systems. Artificial Intelligence can, and should, be seen as a learning partner that nurtures and develops the ability to learn and stimulate learners' intrinsic motivation to participate in and engage in the learning process, and aids the process of active and meaningful learning engagement, without displacing the teacher. This study adds to the existing body of work by describing and elucidating some of the psychological elements of the collaboration between humans and AI and the subsequent effects on learners. Thus, to realize the optimal advantages of education and the cultivation of critical skills that AI offers, higher learning institutions, educators, policymakers, and educational technology designers are encouraged to support AI in a responsible and learning-centered manner, while preparing learners for the new digital learning contexts they are likely to encounter in the future.

Recommendations

1. Educational institutions should integrate AI-assisted learning technologies into teaching and learning practices to enhance student learning outcomes.
2. Universities should provide training programs to improve students' AI literacy and effective use of intelligent educational technologies.
3. Educators should encourage the responsible and ethical use of AI while promoting critical thinking and independent learning.
4. AI-based educational platforms should be designed to strengthen students' trust, motivation, and self-regulated learning through personalized feedback and adaptive learning features.
5. Higher education institutions should ensure equal access to AI-assisted educational resources for students across different academic disciplines and backgrounds.
6. Policymakers should develop clear guidelines and ethical frameworks for the safe, transparent, and responsible implementation of AI in education.

7. Future researchers should examine additional psychological, technological, and institutional factors influencing human–AI collaboration using longitudinal or mixed-method research designs across different educational contexts.

Future Implications

The results from this research indicate that the integration of human–AI collaboration will be imperative in shaping the future of higher education. As AI becomes more sophisticated, it is likely that education systems will embed AI to facilitate the personalization of learning, create flexible learning assessments, and engage with various teaching methodologies based on analyzed data. It is anticipated that future education models will prioritize the collaboration of students with AI, where both critical thinking and the ability to learn autonomously will be showcased through adaptable digital skills. It is also crucial that ethical and transparent AI systems aimed at improving learning outcomes be developed in collaboration by educators, policy-makers, and AI developers. Consideration of the privacy of learners and the protection of the integrity of learning will be essential in this collaboration. The collaborations will be the foundation of the future research extending the human-AI collaboration within education towards the new AI technologies, different educational contexts, and other psychological and behavioral perspectives.

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