

AI Supported Differentiated Instruction Cognitive and Emotional Outcomes for Diverse Learners

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ARTICLE INFO			ABSTRACT
Article History:			<i>The aim of the current study was to find out the effects of AI-based differentiated instruction on the university student body's cognitive and emotional performance. It was quantitative research, and a sample of 280 students was chosen by the use of the simple random sampling procedure in both privately and publicly owned universities. The analysis was done through descriptive statistics, Pearson correlation, simple linear regression, and t-tests of independent samples. The results demonstrated the existence of serious positive associations amid AI-supported differentiated teaching and cognitive and emotional results, hence supporting Hypothesis H1. Regression analysis revealed that AI-based instructive strategies were significant predictors of education and emotionally satisfying outcomes of academics, and this supports Hypothesis H2. There was an absolute demonstration of Hypothesis H3 since the t-test outcome indicated that the performance of students undergoing instructions through AI-supported differentiation instructions was significantly better both emotionally and cognitively than those who did not undergo the instructions. These findings are associated with the recent studies that encourage implementing adaptive and emotionally responsive AI technologies in college learning. Following the outcomes, the research concludes with the fact that AI-facilitated differentiated teaching has not only academic but also emotional resilience and presents useful implications, making references to curriculum designers, educators, and policymakers. It also implies that there is a need to conduct research studies in the future regarding the long-term effects and equal access to AI-based learning environments.</i>
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Introduction

Over the last several years, Artificial Intelligence (AI) has managed to enter the educational systems and, consequently, transform the conventional form of teaching, offering new solutions to the problem of learner diversity. Common blanket nature of instructions delivery has a detrimental effect on the heterogeneous classroom setting where the considerations of individual learning needs, preferences and abilities are overlooked. Considering the highly differentiated classrooms in terms of the cognitive ability, the cultural background and the socio emotional needs the differentiated instruction is also in high demand. Differentiation of instruction incorporates the modifications of the teaching content and processes and products and teaching learning environments to fit learner variance. This technology has been of practical use in the development of adaptive and personalized learning because it is capable of accessing past performance of students as well as predict learning behaviour using AI technology. In the modern world, researchers observe higher education systems powered by AI and suggest that it can dynamically vary the learning resources based on the achievements of the learners in real-time (Zhou et al., 2023), which creates a more egalitarian environment of learning.

The use of AI in differentiated instruction is not merely post-modification of educational contents to conform to parliamentary issues of the students in relation to their intellectual and emotional capacities. It is possible to consider cognitive outcomes that can be measured as the enhancement of knowledge, problem solving ability, retention and critical thinking, which can be taken as cognitive outcomes. On the other hand, there are emotional consequences, such as motivation, self-efficacy, decrease of academic anxiety and satisfaction of learners, in general. Thanks to the AI-based technologies, such as those provided by intelligent tutoring systems, adaptive learning platform, emotion recognition applications, educators can now not only boost academic performance but generate positive emotional experiences. What these tools do give is scaffolding, real time feedback and personally attuned interventions and emotional attuned interventions that have proved to bring the academic confidence factor off the peg and the engagement of students up or up the peg. It was revealed that differentiated instruction associated with AI intervention creates the significant beneficial impact on both cognitive development and emotional well-being due to ensuring the supportive, inclusive, and individualistic educational context (Ahmed et al., 2024).

To complement them, one cannot neglect the role of AI in the context of differentiated instruction in the regard to the concept of diverse learners when speaking about the learners who have special educational needs, language issues or socio-economic background. Such students tend to have problems accessing typical teaching strategies that result in educational disparities. The technology in the form of AI-assisted systems will be capable of not only predicting the presence of specific teaching gaps, cognitive predilections, or emotional demonstrations, but, therefore, can enable the provision of instructors with the information on how to modify the mechanisms they use in teaching. To put it in an example, the AI algorithms can recommend the supplemental materials that will help to make the student perform better in the areas of his/her weakness and the additional materials to better challenge students and be able to give both types of students a serious challenge. The latest studies show that personal learning paths developing due to AI-type systems, provide very high student satisfaction, superior performance and reduced dropout incidence in inclusive environments (Chen et al., 2023). The differentiated teaching which is backed by AI thus, can assist in the eradication of the long-term inequality prevailing in a given system of education via the academic and emotional inclusiveness.

The timely assessment and succession of students is necessary, which is conducive to the implementation of the differentiated instruction with the assistance of AI, which implies the best student experience in personalized learning. As opposed to traditional assessment practices which

tend to be summative and very rarely based, AI systems enable real-time assessment practices that are formative in nature and thus supporting both the learners and the educator in identifying areas that require further improvements. Such analytical tools based on AI can trace the interaction levels of the learners, learning retention as well as their accuracy in responding to questions and act accordingly. This timeliness of such insights does not only promote academic performance but also helps alleviate learner frustration and cognitive overload as it can increase or decrease content difficulty and pace as each student requires. The emerging body of research emphasizes that AI-empowered instructive conditions of adaptive learning greatly improve students' metacognitive self-knowledge and academic self-regulation, which are key predictors of educational achievement and success, particularly in the classroom setting characterized by diversity (Kaur et al., 2024).

AI-Supported Differentiated Instruction

Artificial intelligence (AI) has transformed education in the modern world and is providing scalable solutions in a dynamic way that enables customized teaching. The application of teaching strategies in differentiated instruction means fitting the learning needs, abilities, and preferences of students so as to access equitable educational opportunities among students. Traditional teaching delivery systems also find it difficult to respond in real time to the cognitive levels, emotional conditions, and learning speeds of students in diverse classrooms. With the help of AI, differentiated instruction closes this gap as it engages the adaptive algorithm, data analysis, and intelligent tutoring, providing the delivery of content, assessments, and feedback to each learner by utilizing individual learner profiles. By constantly observing the progress of students and their conduct, the AI-based tools provide personalized resources and interventions that suit the learning styles and the academic needs of the individual students. It is highlighted in more recent research that AI-assisted systems facilitate an effective delivery of instructions through dynamic learning pathways, open up access to those with various backgrounds, and allow better parity of learning outcomes in real and virtual classrooms (Vashishth et al., 2024).

One of the strongest aspects of AI-enhanced differentiated instruction is that it can handle large and complicated data about students in an efficient way. The artificial intelligence solutions have the ability to amass and evaluate data concerning the performance of students, their level of engagement, patterns of behavior, and even emotional indications in real time. This volume of information allows AI-driven tools to create a full-blown learner profile that reflects the academic attainments of every learner and his or her learning modes as well as his or her possible areas of weakness. With this analysis, it is possible to develop individualized instructional material and tasks that will be devoted to adjusting the instruction to particular students and their needs and obstacles. Besides keeping students cognitively active, this real-time responsiveness also limits frustration by ensuring that challenges that overwhelm the ability of the students to perform at a certain level do not occur, since the level the students are at is fed back to the computer, which in turn signals a given task based on this level. (Li et al. 2025) state that AI-led adaptive learning technologies can greatly improve academic performance by providing an ability-matched instructional challenge at propitious times when based on data.

The use of AI in differentiated instruction is changing the traditions of educational assessment by focusing on constant and regular analysis (formative assessment) rather than on summative assessment. The AI-based platforms can produce real-time, one-on-one feedback by using the data about the performance of learners to ensure that their instructional delivery can be adjusted in real-time to rectify misconceptualizations and to scaffold concepts that are critical to performing well. This closed cycle of feedback boosts learning efficacy, eliminates academic stress, and develops a growth mindset in students. In addition, AI-based analytics will also help educators with specific data about how classes as a whole and individual learner, in particular, are doing and make

evidence-based decisions during instruction. Continuous assessment systems that are supported by AI, as specified by (Tariq et al., 2024), are proven to have a great positive impact on academic performance because it could be ensured that the teaching process is still in touch with the changing demands of the student, which is promoted through the academic results and learner satisfaction in diverse classes.

Cognitive and Emotional Outcomes for Diverse Learners

The use of artificial intelligence (AI) in teaching and learning processes has created alternative dimensions towards the improvement of cognitive and emotional performance of learners with different backgrounds. Classrooms are nowadays diverse and populated with various students with cognitive, cultural, and socio-economic differences and emotional dispositions and therefore need instructional models that accommodate these differences individually. Such solutions are available through AI-aided differentiated instruction, which atomically manipulates the educational content, fastening, and response to the real-time graphs about the performance, preferences, and levels of involvement of each scholar. This technology will guarantee that students get individualized learning experiences that conform to their diverse academic and emotional requirements. In recent years, studies have indicated that adaptive learning platforms that operate on the basis of AI assist in better knowledge acquisition and learner satisfaction and deactivate the presence of academic anxiety among students in various learning environments (Ahmad, N.R. et al., 2025). The evidence pile is suggesting that the AI-enhanced differentiated instruction is an incredible instrument for fostering advanced learning and emotional stability in inclusive classes.

Cognitively, the use of AI-enhanced differentiated instruction reinforces all-important academic skills, like rational thinking, critical thinking, problem-solving, and auxiliary remembering. Continuous analysis of data collected on the students will help the AI systems to determine the gaps in the learner's cognition and suggest corresponding actions, e.g., suggest extra exercises, scaffolder tutorials, or harder content to the high achievers, etc. This individualized assistance ensures that students are not overburdened with tasks that are too challenging, nor do they lose interest in tasks that are largely too. Cognitive engagement is also widely encouraged by the incorporation of interactive simulations, the indulgence of gamified experiences, and multimedia materials to drive a better understanding and ability to retain knowledge in the long run. Predictive analytics use in adaptive learning systems is also used to project learning challenges in the future to enable timely interventions that cultivate proactive cognitive development. Modern studies validate the idea that these AI-assisted tools have a huge positive impact on student learning outcomes and higher-order thinking abilities, in particular, those whose students represent underrepresented or minoritized populations (Hadar et al., 2025).

Equally important are the emotional outcomes associated with AI-driven personalized learning environments. Emotional well-being is a critical determinant of academic success, influencing learners' motivation, confidence, stress management, and overall engagement. AI-powered emotion recognition systems can interpret students' emotional cues by analyzing facial expressions, voice patterns, and interaction behaviors during learning sessions. This information enables adaptive platforms to respond to learners' emotional states by adjusting content difficulty, delivering motivational prompts, or offering mindfulness resources to support emotional balance. Personalized emotional interventions have been shown to reduce academic anxiety, increase students' sense of belonging, and improve their willingness to engage in challenging learning tasks. Empirical evidence from recent studies highlights that emotionally adaptive AI tools significantly enhance students' motivation, resilience, and academic confidence, particularly in classrooms characterized by diversity and inclusion (Vistorte et al., 2024).

The connection between the cognitive and emotional outcome is heavily interdependent, and one brings forward influence in the other in great ways. Under the conditions of proper cognitive demands, personalized emotional support would result in students expressing more academic perseverance and positive learning attitudes and engaging with the processes. This balance would be achieved with the help of AI-supported differentiated instruction since it allows covering academic challenges and emotional needs simultaneously. To give an example, a student dealing with some difficulties with a certain concept can be provided with simplified material and motivation or stress-management suggestions, which would help to both maintain cognitive concentration and emotional stability. discriminating educational environment where every student can live and learn (Yao et al., 2025). The implementation of AI in education, as (Singh et al., 2024) believe, can contribute to cognitive development but also to the emotional stability of learners, thus becoming a crucial element of the approach to inclusive and equitable education, with the success of all learners remaining in focus.

Research Objectives

1. To examine the relationship between AI-supported differentiated instruction and cognitive and emotional outcomes of diverse learners.
2. To predict the impact of AI-supported differentiated instruction on the cognitive and emotional outcomes of diverse learners.
3. To compare the cognitive and emotional outcomes of diverse learners based on their exposure to AI-supported differentiated instruction.

Problem Statement

In modern multicultural learning environments, because of the diverse cognitive abilities, learning styles and emotional needs, usual homogenous approach to teaching in general does not seem to be the right answer to learning. Such insufficient personalization is one of the causes of the academic performance, engagement of the learner, and emotionality gap, especially of learners who have issues with learning, have a language barrier or socio-economic disadvantages. Although differentiated instruction has been discussed as a practice that is effective at the individual learner level in addressing different needs of the learners, its real-life application is patchy and intensive of resources. The introduction of the Artificial Intelligence (AI) in the educational setup presents a chance to provide students with adaptive and personalized learning by continually examining and analyzing student data and altering teaching content in real time. Nevertheless, there is still a limited amount of empirical evidence in the cognitive and emotional results of AI-assisted differentiated instruction on different learners. In this study, the researcher tries to overcome this gap by conducting research on the relationship, predictive effect, and group variations of AI-supported differentiated instruction on the cognitive and emotional strengths of diverse learners in inclusive classrooms.

Significance of the Study

The given research can be of great importance to teachers, politicians, and developers of educational technologies since it gives empirical evidence on whether AI-assisted differentiated instruction can promote both cognitive and emotional performance of learners with diverse needs. Within a context where classes are growing in their heterogeneity, it is important to know how advantageous the technology of AI-based adaptive systems can be, allowing the creation of individualized experiences in learning that will lead to academic equity. This study will help to add much-needed evidence to the existing base of education technology research through analyzing the relationship, predictive effect, and comparison of AI- based differentiated instruction. The results

will be used to inform educational design practices, help create emotionally intelligent AI-based learning tools and influence policy making decision to facilitate general inclusiveness and learner focused education. Finally, this paper will provide a practical way forward in terms of those guidelines about improving performance, engagement, and emotional health in learning institutions that are diverse and inclusive through the integration of the AI-based solutions to education.

Literature Review

The use of Artificial Intelligence (AI) in the classroom has become one of the most popular models of solving the issue of learner diversity and improving the effectiveness of instructions in the last few years. The static instructional strategies, commonly formulated in terms of equal content distribution and uniform measurement, do not usually satisfy the cognitive demands, emotional needs, and individual learning styles of diverse learners in the expanding heterogeneous classes. Differentiated instruction is a method of teaching that has been proposed to be an effective method of teaching a given course to cater to the needs of the different learners. At the same time, its practical application is rather complicated and demanding in terms of resources, especially in large or heterogeneous classes. To effectively address the issue, AI-facilitated differentiated instruction has already become an effective solution as it involves the use of real-time data analytics and adaptive learning algorithms that personalize content, pacing, feedback, and assessments. The latter was confirmed by the recent studies that showed that AI-powered adaptive learning systems can have a substantial positive impact on teaching and learning due to the ability to deliver personalized and dynamic training activities that support cognitive and emotional needs of students at the same time (Strielkowski et al., 2025).

Building up on this, researchers have turned out to become more concerned in conducting research to understand the impact of AI-based differentiated instructions on cognitive outcomes, which entail problem solving skills as well as reasoning abilities in addition to retention of knowledge and others. The systems based on AI assist a student with his or her learning process by contrasting his or her performance history databases to identify any gaps in their learning knowledge and event predict when the situation becomes difficult to learn, provide tailored learning products and services to ensure he or she optimizes the use of the mind. By becoming cognitive and suggesting a more coherent picture of the situation when the long-term memory has to confront interactive simulation tests, gamified assessment tasks, and formative assessment exercises provided by AI, the learning process draws professionals in the educational field. Empirical studies have noted that adaptive AI assists in documenting positive educational results as well, primarily of the academic kind, and students who identify with underrepresented and marginalized groupings typically struggle with traditional kinds of schooling (Salas-Pilco et al., 2022). This pattern of evidence proves the value of AI-enhanced differentiated instruction in achieving the equal growth of cognitive development in multiple classrooms.

Being quite familiar with the cognitive improvement that AI-enabled learning can offer, the modern research world also focuses on the results based on emotional responses to personalized learning opportunities. Emotional well-being, the combination of things like academic confidence, motivation, anxiety management, and engagement is a significant contributor to overall academic success of the students. Emotion recognition technologies based on AI are able to identify the level of emotions using facial expression analysis, voice modulation, and the pattern of interaction in digital space, and adaptive systems can support the emotional needs of the learner on a real-time basis. These systems of AI can establish psychologically safe and mutually inclusive learning environments by modulating the themes taught, moderating the instructional tempo, and additionally by providing emotional intervention. Research also affirmed that emotionally

intelligent AI-aided learning can increase motivation, minimize academic stress, and make students more emotionally fit in demanding and tough academic situations (Ahmad, N. R et al., 2025). Both cognitive and affective outcomes are equally important and form an important step towards the creation of fully inclusive and student-centered learning systems.

Besides this, scholars have started researching the relationship between cognitive and emotional outcomes in AI-enhanced differentiated instructional frameworks because a person cannot create academic success without focusing on emotions. Emotional support when not available sufficiently can cause disengagement, anxiety and lack of academic confidence, and when available individually tailored to students will result in the improvement of cognitive involvement and perseverance in most difficult activities (Zong et al., 2023). et al., 2025). The AI systems that are able to focus on addressing both areas at once will guarantee that the instructional content will be challenging enough to present the desired amount of challenge and keep emotional balance and motivation levels among the students. The latest evidence shows that conservative blending of cognitive personalization with emotion-sensitive interventions leads to better attitudes towards learning and increase in academic persistence and increases in retention rates in various learners. This comprehensive training technique underlines the opportunity of differentiated guidance with the assistance of AI to foster not only high levels of academic achievements but also positive emotional experiences.

The Evolution of Differentiated Instruction in Diverse Learning Environments

Differentiated instruction was always known as a pedagogical system that is aimed at meeting the academic needs, learning styles, and socio-emotional needs of all represented students in heterogeneous classes. The conventional educational systems that were developed based on standardized curricula and similar ways of delivery instruction, tend to ignore some of the individual differences that are the hallmark of the current classrooms. As stated by (Rajaram, et al. 2023), the growing levels of diversity among student populations in physical and virtual classrooms have escalated the demand of personalized instruction methods that reactively address the nature of individual learners. Whereas significant theoretical advantages of differentiated instructions have been well recognized, its implementation has been met with numerous challenges, including time limit factors, lack of teacher preparation, and access to resources. As (Yambal et al. 2025) stress, though differentiated instructions create equity in academics and improve students' engagement, it is hard to implement in a big classroom with limited resources without the help of technology.

Some of these constraints were mitigated by the introduction of technology in learning environments providing students with tools that enable them to cope with the demands of differentiation relatively easier by the help of teachers. Previous technology-supported differentiation systems involved learning management systems, multimedia content, and computer tutorials, which was not highly customized and individualized, with all their predetermined classifications of learners. The use of AI technologies allows analyzing extensive amounts of data on the performance of students and anticipate the learning progress to automatically modify educational resources on-demand to meet the changing demands of learners. The AI-based systems have largely become successful in inclusive educational settings, which require instructional modifications due to learner diversity at all times. According to (Singh et al., 2024), the use of AI in differentiated instructions makes the process of providing personalized instruction much more accessible and efficient because it enables educators to offer individualized learning to the masses without undermining the quality of instruction.

With the support of such instructional systems, educational institutions are more and more accepting AI-based education. Critical reflection on the overall consequences of such practices on

cognitive and emotional performance among various students is increasingly becoming a necessity. Historically, the concept of differentiated instruction has been rated more on cognitive development involving more personalized approach on student development of academic skills particularly reasoning, critical thinking, problem and knowledge retention bases. Yet, the current educational studies point to the insuperable connection between academic and emotional well-being, stating that emotional well-being impacts motivation, engagement, self-efficacy, and learning resilience in the classes. New evidence has also found that instruction which supports the cognitive needs of all by being learner-specific is helpful; however, it is still inadequate in helping to promote a successful learner holistically where inclusive learning is taken place (Conway et al., 2017). According to (Yao et al. 2025) the next phase of differentiated instruction is to interweave cognitive personalization with emotional responsiveness, to produce dynamic, AI-based and learner-centric landscapes that are responsive to the changing academic and emotional needs of students.

Role of Artificial Intelligence in Modernizing Instructional Practices

The use of Artificial Intelligence (AI) in education has transformed teaching and learning operations at the fundamental level through the provision of adaptive, personalized and data-driven instructional experiences. The AI systems will learn about individual learners, unlike conventional educational technologies, which gather and analyze data only when learning necessitates it, AI systems can learn continuously and make individualized learning pathways accordingly. These digital technologies will be powered by AI and capable of manipulating the difficulty of instruction, suggesting specific resources, and also providing real-time personalized feedback, which will make the instructional strategies far more responsive. (Pedro et al. 2019) note that AI use in education introduces a paradigm shift in teaching strategy beyond simple content delivery to dynamic and individualized examples of instructional models that have the flexibility to deal with the complications of diverse populations of students. The capacity of AI to grapple with the issue of learner diversity using adaptive learning systems is one of the most significant contributions of this technology to contemporary teaching practice. These platforms use machine learning algorithms to determine individual cognitive assets and deficits in each student and hence they can engage in differentiated instructions depending on individual academic profiles.

The AI has also improved cognitive outcomes besides the fact that it has come up with emotion-aware technologies that are sensitive to emotional states of learners when delivering instructions. The emotion recognition tools examine facial expression, speech patterns, interaction patterns, and identify frustrated, anxious or disengaged emotions. This emotional information can be used to dynamically modify instructional material, speed, and response to correct the emotional imbalance by issuing motivational reminders, relaxation techniques or adjust tasks or speed (Sethi et al. 2024) highlight that the addition of emotional sensitivity in AI-facilitated learning has played a critical role in enhancing the level at which the learners are engaged, their academic confidence, as well as the durability of the learners in problematic studies, especially in diverse classrooms and the ones with very diverse emotions. In contrast to customary assessments that are regularly summative and periodic, AI-based systems observe learner progress in real-time and relax or challenge control over the level of instructions according to performance patterns. This makes sure that the learners are not overstimulated mentally where they end up being frustrated or overworked.

With instructional practices in the educational setting being redesigned and revamped by the power of AI, it is becoming clearer than ever that the possibilities of AI go far beyond the traditional limits of delivering an academic content or a course. The use of AI is no longer about automatizing assessment or making academic materials more personalized; it is gradually turning into a holistic solution that is capable of supporting holistic, learner-centered education that caters to a wide

range of both academic and emotional needs of the students. The combination of adaptive cognitive scaffolding systems, emotion-sensitive interventions, and sustained in-progress formative evaluations leads to AI-influenced instructional platforms in which dynamic, inclusive, and responsive learning systems are established where learners are exclusive of their profiles. These systems not only adapt knowledge, delivery, and speed depends on the performance of the learner but also keep track of the emotional status of the learners to better deliver interventions at the right time and at the right level to continue building interest and dedication. (Kayyali et al. 2024) argue that the future of AI on education will be in the creation of conjoined, intelligent platforms that can handle the cognitive challenges as well as emotional health concurrently. Those platforms have the potential to mitigate academic anxiety, resilience and offer academic confidence and encourage critical thinking, problem solving and higher order thinking abilities.

Research Hypotheses

1. **H1:** There is a significant relationship between AI-supported differentiated instruction and the cognitive and emotional outcomes of diverse learners.
2. **H2:** AI-supported differentiated instruction significantly predicts the cognitive and emotional outcomes of diverse learners.
3. **H3:** There is a significant difference in the cognitive and emotional outcomes of diverse learners based on their exposure to AI-supported differentiated instruction.

Methodology

Research Design

In this research, the quantitative research design was used to explore the connection between AI-aided differentiated instructions and cognitive and emotional outcomes of diverse learners. The quantitative method was said to be appropriate in that it enabled the objective measurement of variables, the determination of statistical relationship, and outcomes can be predicted using a specific population. The combination of correlational, predictive and comparative components of the study design allowed studying not only the association between the variables but also the possible predictive and group differences and attrition. The extent of the links between AI-supported instruction and learner outcomes was determined by correlational analysis, whereas by means of regression analysis, it was possible to predict the cognitive and emotional outcomes on the basis of received exposure to AI-supported differentiated instruction. Also, the ANOVA or t-test methods were used to compare the difference in the outcomes between the groups of learners. The multi-faceted quantitative design was able to guarantee the research objectives have been met using reliable and statistically viable procedures.

Population

Population in this research work was the students attending colleges and universities in Punjab who were taking their short-term and the postgraduate courses in the various higher institutions of learning in the province of Punjab in Pakistan. The selection of this population was informed by the phenomenon of the growing integration of AI-driven instructional systems into the learning environment of higher education institutions in Pakistan and the high variability in the nature of learners in these contexts. The students were of diverse academic subjects, cognitive skills and socio-affective backgrounds hence it was an appropriate sample to screen a study to look at differentiated teaching in A.I assisted learning classrooms. Moreover, the choice of such a population was motivated by the fact that recently, educational reforms to embrace technology-mediated learning and AI-driven intercession have been promoted at Pakistani universities, and

these institutions became the perfect places to discuss the research intention. The study became more relevant and beneficial through the population who was well acquainted with digital learning facilities and those powered up by artificial intelligence systems.

Sampling Technique

Simple random method of sampling was used to sample the participants out of the target population. The reason attributed to the method as it was aimed at giving every student in the specified population an equal opportunity of being picked in the sample and this minimized the chances of selection bias. By applying random sampling, it was guaranteed that the sample reflected the larger population regarding the academic level, gender and discipline as well as socio-economic background. This method was quite suitable to quantitative research with aims to have a generalizable study conclusion, since it aided in validating that a study could be generalized to other populations in addition to the participants in the study. Sampling was done on the list of students given by each of the participating institutions and sampling on each list was randomly carried with the help of random number generation using a computer. This process ensured that all the participants were selected in an objective manner and there were minimal possibilities that could result in the biased selection due to the researchers. It also increased validity of the results of the study, as it encourages equality and representativeness in the sampling of the participants.

Sample Size

The sample size of the research was completed with 280 students of different universities in Punjab: public and private. This sample was arrived at after having studied the past literature and the levels of statistical power required to carry out correlation, regression, and ANOVA or t-test studies. It was felt that this kind of sample was adequacy to identify significant relationships and differences among variables and reduce the possibility of Type II errors. Also, the selected sample size enabled the study to compare the subgroups regarding such factors as academic level, gender, and exposure to AI instructions, which contributed to the increased richness of the analysis. The participation of 280 people helped to maintain a balanced representation category with regard to diverse demographics and academic divisions. This sample size also exceeded suggested cut-offs of predictive and correlational studies thereby justifying the validity and strength of the statistical inference

Ethical Considerations

All participants were selected using the strict ethical requirements to safeguard their rights, dignity, and privacy. Prior to data collection, all the respondents were adequately sensitized on the purpose of conducting the survey, its process and the voluntary nature of the process; all the respondents gave an informed consent to the study. It has also been explicitly explained that the participants can terminate the study at any point without subjecting themselves to any adverse effect. In order to observe confidentiality, no personal information was noted and all the answers were anonymous during the process of the research. Information gathered was stored in password-protected digital files that only had access to the main researcher. Moreover, the participants were also assured that the information would be utilized purely on academic and research purposes. The research was done in such a way that no psychological, emotional or academic damage would occur with participation. Ethical clearance of the study was obtained before the data collection was done through the institution ethics review. The issue of transparency in reporting results and absence of data fabrication or manipulation were also of ethical importance.

Data Analysis

In this study, statistical data analysis was carried out through the use of Statistical Package of Social Sciences (SPSS) 26 version. To describe the demographic features of the respondents a descriptive statistic, frequency, percentage, the means, and standard deviations were computed. Inferential statistical method was used to test the research hypotheses. Pearson Product-Moment Correlation was applied to test how AI-supported differentiated learning is linked to cognitive and emotional performance of different students (H1). Analysis of simple linear regression was used to identify the strength of AI-supported instruction on these results (H2). Moreover, the independent samples t-test was used to relate cognitive and emotional performance students who were exposed and not exposed to the AI-supported differentiated instruction (H3). All the statistical tests would have a significance level of $p < 0.05$, which gave the results reliability and validity.

Table 1: Demographic analysis

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	140	50.0%
	Female	140	50.0%
Academic Level	Undergraduate	160	57.1%
	Postgraduate	120	42.9%
Type of Institution	Public University	150	53.6%
	Private University	130	46.4%
Exposure to AI-Supported Differentiated Instruction	Exposed	160	57.1%
	Not Exposed	120	42.9%

The demographic characteristics among the 280 respondents showed that there was equal representation regarding gender since there were 50.0 % male and 50.0 % female respondents. In terms of academic level, the largest proportion of the respondents was at undergraduate level comprising 57.1 percent of the sample size, with majority being at postgraduate level at 42.9 percent. With regard to institutional type, 53.6 percent of the sampled were those in a public university and 46.4 percent, in a private university. It is noteworthy that 57.1 percent of the respondents have had an exposure to AI-supported differentiated instruction whereas 42.9 percent have not had an exposure. This distribution implies the relatively equal representation of demographic variables, which guarantees the balanced prism to examine the implications of using AI-supported instructional practices on the cognitive and emotional outcomes of diverse learners.

Figure 1:

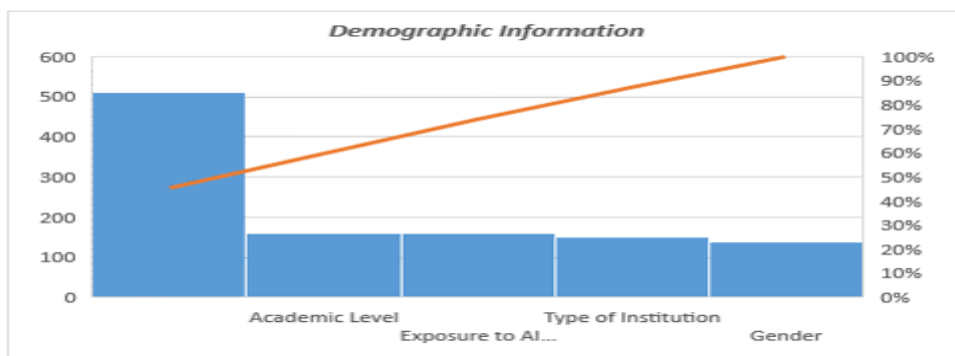


Table 2: Correlation Analysis

<i>Variables</i>	<i>r</i>	<i>p-value</i>	<i>Interpretation</i>
AI-Supported Differentiated Instruction ↔ Cognitive Outcomes	0.65	0.000	Significant positive correlation
AI-Supported Differentiated Instruction ↔ Emotional Outcomes	0.58	0.000	Significant positive correlation

The correlation analysis had shown that there was a significant positive correlation between differentiated instruction and the cognitive and emotional performances of the diverse learners which was supported by AI. In particular, the fact that AI-based differentiated instruction had strong positive value of correlation ($r = 0.65$, $p < 0.001$) with cognitive outcomes showed that learners with higher levels of AI-rooted, one-on-one instructional support achieved better cognitive performance with improvements in reasoning, problem-solving, and knowledge retention. Also, the emotional results were significantly correlated with AI-based differentiated learning instruction ($r = 0.58$, $p < 0.001$), implying that by demonstrating AI-based emotional learning environments, a learner would become motivated, experience less scholarly anxiety, and be more satisfied. These results confirm the Hypothesis H1 and indicate the bifaceted contribution of AI-augmented differentiated instruction to the academic performance and emotional well-being of diverse students in the university.

Table 3: Simple Linear Regression

<i>Dependent Variable</i>	<i>B (Unstandardized Coefficient)</i>	<i>β (Standardized Coefficient)</i>	<i>t-value</i>	<i>p-value</i>	<i>R²</i>	<i>Interpretation</i>
Cognitive Outcomes	0.68	0.65	12.34	0.000	0.42	Significant positive predictor
Emotional Outcomes	0.54	0.58	10.76	0.000	0.34	Significant positive predictor

The findings of the simple linear regression analysis proved that differentiated instruction with the use of AI to support them was a significant positive predictor of cognitive and emotional outcomes of diverse learners. Namely, AI-facilitated teaching systematically forecasted cognitive performance ($B = 0.68$, 0.65 , $t = 12.34$, $p < 0.001$), and the results showed that 42 percent of the variance in the cognitive performance of the students is explained by the R^2 value of 0.42. It implies that the increased standards of anticipatory instructional adjutance are related to significant gains in the knowledge retention, critical thinking, and problem-solving skills of the students. Also, differentiated instruction with AI support made significant contribution to emotional outcome ($B = 0.54$, 0.58 , $t = 10.76$, $p < 0.001$) as it explained 34 percent of variation in the emotional well-being of learners indicating R^2 value as 0.34. These findings suggest that AI-enabled emotionally adjustive models of teaching methods make learners more motivated, more academically confident and less panicked. In sum, these results are handy to the Hypothesis H2 and indicate the predictive power of AI-enhanced differentiated instruction on cognitive and emotional outcomes, in shift classrooms settings.

Figure 2:

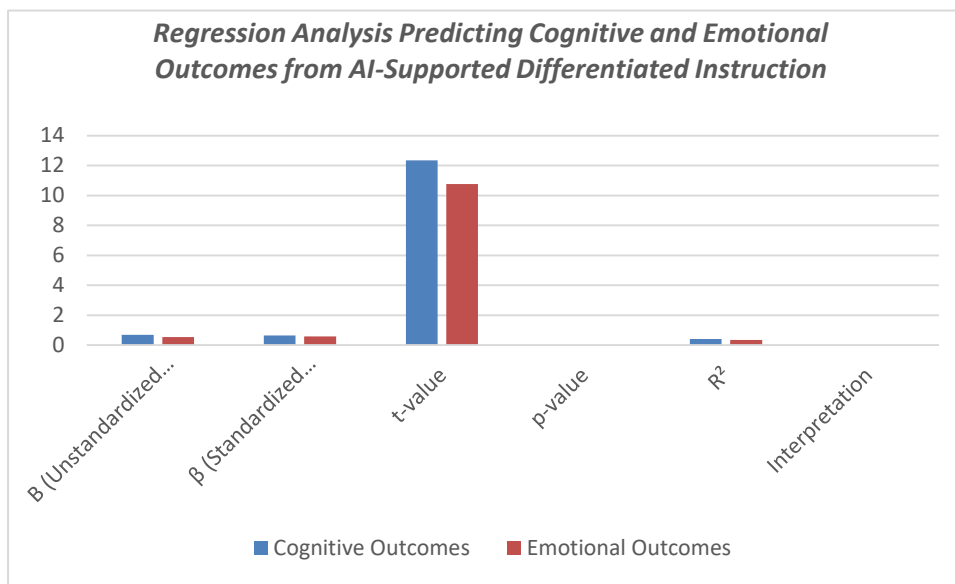
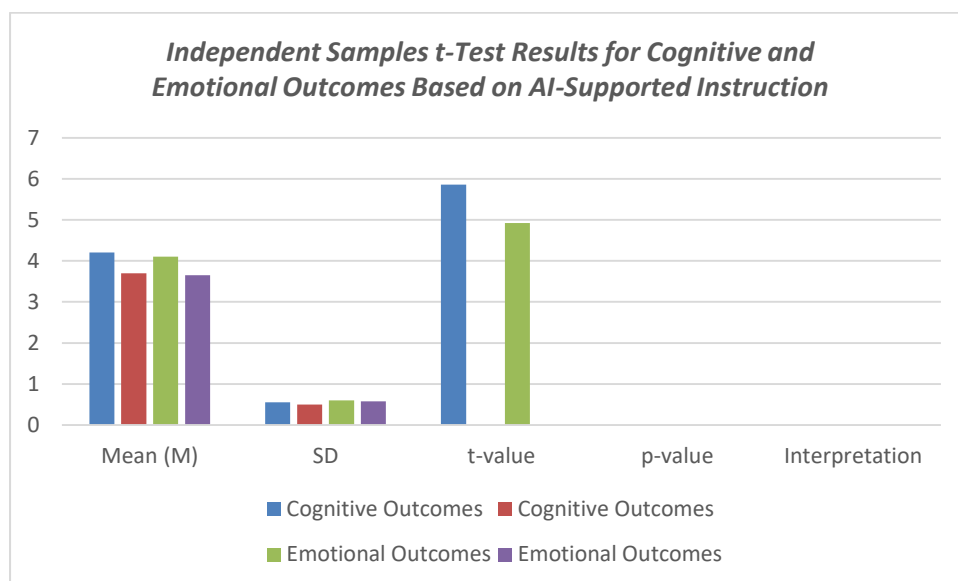


Table 4: Independent Samples t-Test

Outcome Variable	Group	Mean (M)	SD	t-value	p-value	Interpretation
Cognitive Outcomes	AI-Exposed Group	4.20	0.55	5.86	0.000	Significant difference
	Non-Exposed Group	3.70	0.50			
Emotional Outcomes	AI-Exposed Group	4.10	0.60	4.92	0.000	Significant difference
	Non-Exposed Group	3.65	0.58			

The independent samples t-test results showed that there was a significant difference between the cognitive outcomes as well as the emotional outcomes of students who were exposed to AI-supported differentiated instructions and those who were not. In cognitive outcomes, the result showed that the mean difference between the AI-exposed and non exposed groups was statistically significant ($t = 5.86$, $p < 0.001$) with the former having a higher score ($M = 4.20$, $SD = 0.55$) than the latter ($M = 3.70$, $SD = 0.50$). Likewise, there was a tremendous disparity in the emotional result since the AI-exposed group had a mean score of 4.10 ($SD = 0.60$), which is much greater than the non-exposed group, with a mean of 3.65 ($SD = 0.58$), as the t-value is 4.92 and $p < 0.001$. The findings suggest that students who have received AI-supported differentiated instruction scored better in terms of cognitive abilities as well as described a higher level of emotional well-being as compared to those who have not had such an exposure. The findings give substantial arguments in favor of Hypothesis H3 to prove that the AI-infused learning environment significantly results in the quantifiable gains of the academic and emotional experiences of diverse students and learners.

Figure 3:



Discussion

The purpose of the present study was to examine the connection between AI-supported differentiated instructions and cognitive and emotional results of diverse university students in Punjab, Pakistan. The results indicated strong positive relationships among AI-supported instruction and cognitive, as well as emotional consequences, thus defending the Hypothesis H1. All these findings align with studies conducted by (Rane, et al. 2023) who also found that learning environments that integrate AI provide a more effective cognitive engagement and academic output of students due to delivering personalized learning materials and responsive feedback. A very high relationship found in this research shows the increased potential of the AI technologies to aid in differentiated instruction strategies to target various needs of learners in higher education. To facilitate these findings, a regression analysis was performed that showed that AI supported differentiated instruction strongly predicted cognitive and emotional outcomes supporting Hypothesis H2. Learners that were exposed to AI had a superior knowledge retention rate, problem-solving abilities and levels of motivation than their peers.

This goes hand in hand with decision of the (Shi et al. 2025) who has studied that adaptive learning systems with the help of AI offer real-time adaptive scaffolding and emotionally sensitive feedback and the outcome was that there was an improvement in academic confidence and a decrease in academic anxiety in the students. The level of predictive strength observed in the current research supports the idea that the use of AI-assisted instructional models does not only enhance academic performance but also contributes to a positive emotional learning process, which is the foundation of a nurtured student development.

In addition, the independent samples t-test indicated that there was a significant difference among cognitive outcomes and emotional outcomes of the exposed and non-exposed students to learning AI-based differentiated instructions supporting Hypothesis H3. With AI-enhanced learning, there are always higher scores on both variables of outcome. These findings are aligned with the findings of (Mudkanna et al. 2025), who determined that an AI enhanced instructional platform facilitates inclusive learning methods, eliminating performance disparities with the help of graduated content difficulty and variable delivery rates in accordance with individual learners and their cognitive profile, as well as emotional temperaments. The correspondingness of the results accounts further in the importance of AI-aided differentiation of establishing fair and learner-friendly academic environments.

The positive results associated with the study are based on actual consequences that continuously exist underlining the significance of adopting the concept of AI-supported differentiated instruction in academic environments where there are various learners as it is the case with a country such as Pakistan where the diversity of learners is growing in number. These findings are topical and practically important because of the recent educational reforms, encouraging the shift towards the digitalization of higher education. Integrations of emotional personalization with emotion-aware engagements with the help of AI platforms will not only guarantee academic perfection but also emotional well-being of students. The results of this study further support that point of view, implying that the usage of AI is relevant to the academic and more emotional aspects of student success. This research provides an excellent contribution to educators, policymakers, and instructional designers because they can apply this study by which the dual advantages of engaging in AI-supported differentiation into educational practice have been confirmed.

Conclusion

This was a study examining how AI-aided differentiated instructions influence the cognitive and emotional performance of various university students in Punjab, Pakistan. The results showed that there were strong positive correlations among AI-supported instructional methods and mental performance, as well as emotional wellness. The regression analysis has proved that augmented-intelligence guided teaching methodologies are useful in forecasting the academic-related and emotional well-being enhancements of the students. Also, the t-test results indicated that students who have been exposed to AI-assisted learning conditions are more cognitive and emotional than others who have not been subjected to such conditions. These findings match the evidence that has been previously gathered in the study of the importance of AI in developing adaptive, inclusive, and emotionally sensitive academic environments. The study strengthens that the use of AI technologies in the process of differentiated instruction contributes to a better academic performance and emotional satisfaction. The importance of this two-pronged effect is to advance equitable as well as student-centered education. Findings of the research add to the exiting body of evidence facilitating the use of AI in higher education.

Recommendations

1. Colleges and universities are advised to incorporate the differentiated instruction systems with the aid of AI in order to promote the cognitive and emotional performance of students.
2. Curriculum developers ought to come up with flexible learning platforms which change levels of feedback and difficulty of a learning material in accordance to the real-time operations and emotions of students.
3. Professional development opportunities should be implemented to train the qualifications of teachers on how to implement AI-powered educational tools in various classroom environments.
4. The institutions must acquire or install advanced artificially intelligent systems of emotion recognition and learner analytics to track the performance and welfare of the students.
5. The policymakers are advised to give their utmost attention to integrating the AI-backed personalized learning programs in the national education technology platforms.
6. Future studies ought to be used to determine the long-term impact of AI-enhanced differentiated instructions to sustainability of learners, graduation, and career assimilation.

7. Educational platforms with AI support ought to be designed to deal with the specific needs of groups of marginalized and underperforming students to facilitate academic equity.
8. Institutional leadership also needs to advocate work among the AI developers, educators, and psychologists to form emotionally smart and inclusion-based AI learning approaches.

Future Implications

This study has some significant implications on future education practices and research based on the findings made on this study. Because differentiated instructions with the help of AI have been found to bring about significant achievements in terms of cognitive and emotional improvements, its implementations in the university curriculum need to be considered as a top priority. Educational policymakers should appreciate the usefulness of adaptive systems that employ AI in developing inclusive and learner-centered environments. In future studies, the scalability and the long-term educational advantages of AI-facilitated instruction in contrasting fields and in education levels are to be tested. It is also necessary to determine the ways, in which AI-based tools will minimize academic inequalities in the marginal groups of learners. Such adaptive learning technologies need to be developed through collaboration to include educators, AI developers, and educational psychologists to make the technologies emotionally affable. Second, under further research, one may explore how learning with the help of AI is correlated with the development of digital literacy and learning to self-regulate the process. The extension of such research will be beneficial to gain knowledge about sustainable models of education that is enhanced by technology.

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