

Analyzing the Impact of AI on Student Engagement and Interaction in Virtual Learning Environment

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Abstract

This research examines the novel impact of Artificial Intelligence (AI) on personalised learning, interaction, engagement, academic success, and overall satisfaction among students in online and distance education settings. Distinctively, this study focuses on a specific context by analysing data from Pakistani online and distance learning environments, contributing unique insights from an under-explored educational setting. Employing a quantitative research approach, data were gathered through a structured questionnaire administered to 99 students enrolled at various institutions across Pakistan, selected via simple random sampling. Descriptive statistics and Pearson correlation analyses were utilised to interpret the data. Results reveal that AI significantly enhances personalized learning, with 85.9% of students agreeing that AI effectively meets their individual learning needs. Additionally, 71.7% of respondents reported increased engagement with course content as a result of AI integration. While AI substantially improved personalized academic support (74.8%), its capacity for fostering peer collaboration (59.6%) and instructor interactions (44.4%) shows room for advancement, signalling novel areas for further technological development. The correlation analysis further highlights strong positive associations between personalized learning and student engagement ($r = 0.706$), academic support ($r = 0.661$), and overall student satisfaction ($r = 0.709$). These findings underscore the transformative potential of AI in shaping personalised and interactive educational experiences, emphasising a unique context and suggesting future research directions that address collaborative and social learning dimensions.

Keywords: Artificial Intelligence, Personalized Learning, Interaction, Engagement, Academic Success, Student Satisfaction.

Introduction

Artificial intelligence has the potential to significantly transform the way teachers and students communicate with one another in the classroom. Teachers can identify areas where students may be struggling, personalize learning experiences for each student, and provide targeted support and resources by leveraging AI-powered technologies. Additionally, teachers can benefit from AI by having more time for one-on-one contact with pupils, as it streamlines administrative work. AI can also track student development and forecast future performance by analysing student data, enabling teachers to make more informed decisions in the classroom.

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Incorporating AI into the classroom has the potential to increase student learning and academic results.

According to Kamalov et al. (2023), AI in education has the potential to revolutionize the way learning is delivered; however, it is essential to address concerns related to data privacy, bias, and ethics. Empirical studies are needed to provide concrete results and measure the impact of AI on learning outcomes and teaching efficiency.

Hussain et al. (2022) explained in a study that Artificial intelligence has the potential to enhance the learning quality in higher education by interpreting human problem-solving abilities. Its impact on learning techniques and objectives can significantly shape the future success of students in higher academia.

Recent literature highlights the transformative impact of Artificial Intelligence (AI) on reshaping educational environments across various contexts. Galindo-Domínguez et al. (2024) explored the perspectives of in-service teachers in Spain. They found that integrating AI in classrooms enhances instructional delivery but requires targeted teacher training and ethical awareness to be fully effective. Complementing this, García-Martínez et al. (2023) confirmed, through a systematic review and meta-analysis, that AI and computational sciences significantly enhance student performance and motivation, particularly in STEM disciplines. Hussain et al. (2022) further emphasized that AI technologies enhance learning quality in higher education by simulating human problem-solving and adapting to individual learning paths, thereby supporting academic success. Kamalov et al. (2023) discussed the broader implications of AI as a multifaceted revolution in education, advocating for the development of sustainable and ethical AI adoption frameworks to address concerns such as data privacy and algorithmic bias. Similarly, Nuryadin and Marlina (2023) provided a comprehensive literature review, indicating that AI fosters personalized learning and efficiency in content delivery; however, its long-term pedagogical impacts warrant further exploration. Collectively, these studies reinforce the growing consensus that AI holds immense potential to enrich educational experiences, provided it is implemented with strategic foresight and pedagogical alignment.

Crompton (2023) identified key applications of Artificial Intelligence in education, noting its primary use in areas such as assessment and evaluation, predictive analytics, AI-powered assistance, intelligent tutoring systems, and the management of student learning processes. The study also pointed to existing gaps in the literature, particularly the need for further exploration of emerging tools like ChatGPT, which present promising avenues for future research. Crompton emphasized that to remain relevant in the digital age, educational systems must be transformed and adapted accordingly. He further stresses the importance of developing collaborative frameworks that enable humans and intelligent systems to work together to drive innovation, productivity, and societal progress.

Chen et al. (2020) were of the view that AI has had a significant impact on education in terms of administration, instruction, and learning. AI technologies have brought about improvements in efficiency and effectiveness in various educational functions such as grading, curriculum customisation, and personalised learning. Moreover, the use of AI in education has enhanced the overall quality of learning experiences for students and has contributed to increased retention rates. These findings suggest that AI has the potential to revolutionize the education sector, ultimately improving outcomes for both learners and educators.

Martínez et al. (2023) explained that Artificial intelligence (AI) and computational sciences are being increasingly integrated into education to improve student achievement, particularly in STEM areas. The impact of AI components and computational sciences on student performance was found to have a positive effect on student attitudes towards learning and motivation. However, the implementation of these technologies presents educational and ethical challenges for teachers that require further analysis.

Das et al. (2023) emphasise that AI-powered personalisation is poised to revolutionise the education sector by redefining how instructional content is delivered and how students interact with learning. AI technologies, particularly adaptive learning platforms, enable content to be tailored in real time to suit individual learning styles, paces, and needs. This customization leads to more efficient, engaging, and learner-centred environments where one-size-fits-all models do not bind students. Instead, they benefit from lessons that respond to their progress and challenges, potentially leading to improved academic outcomes and increased motivation. Moreover, the integration of AI supports a shift from traditional instructional approaches toward more data-informed, responsive pedagogies. However, the full potential of AI in education can only be realized if ethical concerns, such as data privacy, algorithmic bias, and transparency, are systematically addressed. Equally important is the professional development of educators; without adequate training, teachers may struggle to effectively implement AI tools in their classrooms or interpret AI-generated insights for pedagogical decision-making. The implications of AI-driven personalization extend beyond technological innovation. They reflect a broader transformation in the educational landscape, affecting not only how students learn but also how instructors teach and how institutions design curriculum and support services. As AI continues to evolve, its role in shaping student engagement, academic support systems, and teaching methodologies will become increasingly central. This evolution signals a shift toward more intelligent, inclusive, and future-ready education systems that place learners' needs at the core of instructional design.

Research Objectives

The objective of this study is to:

- Identify the effect of AI on students' personalised learning experiences, and analyse the role of AI in increasing engagement and interaction in online and distance learning environments.
- Investigate the role of AI in providing academic support specific to student needs.
- Assess the students' overall satisfaction with their learning journey using AI technologies.

Research Questions

Q1: What is the impact of Artificial Intelligence on students' personalised learning experiences?

Q2: What is the impact of AI in enhancing AI student interaction, engagement, and collaboration in online or distance educational settings?

Q3: What is the effectiveness of using AI in providing personalised academic support and improving access to learning resources?

Q4: What is the role of AI in influencing students' overall satisfaction with their learning journey?

Research Methodology

This study employed a quantitative research design to investigate the impact of Artificial Intelligence (AI) on personalised learning, interaction, engagement, academic support, and overall satisfaction in online and distance education environments. A structured questionnaire was used as the primary data collection tool, consisting of 29 items measured on a five-point Likert scale ranging from "strongly disagree" to "strongly agree." The instrument was developed to assess multiple dimensions of AI integration in education, including its effectiveness in enhancing learning experiences and student outcomes.

The sample comprised 99 students enrolled in various online and distance learning programs across Pakistan. Participants were selected using a simple random sampling technique, ensuring an equal probability of selection and minimising selection bias. The sample included both male and female students from diverse age groups and academic backgrounds, with a

majority holding postgraduate qualifications and substantial experience in teaching or a professional field.

To ensure the reliability of the measurement instrument, Cronbach's Alpha was computed, yielding a value of 0.944, indicating excellent internal consistency. Data analysis was conducted using descriptive statistics to summarise participant demographics and response distributions. In contrast, inferential statistics, specifically Pearson correlation analysis, were employed to assess the strength and direction of relationships between key variables, including AI's influence on personalised learning, interaction and engagement, academic support, and overall student satisfaction.

This methodological approach enabled a rigorous examination of students' perceptions regarding AI's role in their academic experiences, facilitating the identification of significant patterns and associations that support the study's objectives.

Data Analysis

Table 1: Gender wise participation

	Frequency	Percent	Valid Percent	Cumulative Percent
Female	66	66.7	66.7	66.7
Male	33	33.3	33.3	100
Total	99	100	100	

Female participants constitute 66.7% of the sample, indicating a majority female representation in perceptions about the impact of AI on the students different learning experiences.

Table 2: Age wise participation

	Frequency	Percent	Valid Percent	Cumulative Percent
20-30	22	22.2	22.2	22.2
30-40	75	75.8	75.8	98
50 Years and Above	2	2	2	100
Total	99	100	100	

Table 2 shows that the group with 30–40 years (75.8%), suggesting most respondents are likely mid-career professionals or experienced learners.

Table 3: Qualification

	Frequency	Percent	Valid Percent	Cumulative Percent
Bachelor's degree	5	5.1	5.1	5.1
MS/MPhil	77	77.8	77.8	82.8
PhD	17	17.2	17.2	100
Total	99	100	100	

Table 3 shows that a large proportion hold MS/MPhil degrees (77.8%), suggesting a highly educated group.

Table 4: Work Experience

	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 5 Years	22	22.2	22.2	22.2
6-10 years	11	11.1	11.1	33.3
11-15 years	26	26.3	26.3	59.6
16-20 years	30	30.3	30.3	89.9
more than 20 years	10	10.1	10.1	100
Total	99	100	100	

Table 4 shows that most participants have significant teaching or academic experience, with 30.3% having 16–20 years, indicating their responses are informed by substantial professional expertise.

Table 5: Reliability Statistics

Cronbach's Alpha	N of Items
.944	29

The Cronbach’s Alpha value of 0.944 reported in this study indicates excellent reliability, showcasing that the items in the measurement instrument are highly consistent in assessing the intended constructs. This high level of internal consistency suggests that the survey items reliably measure related dimensions, such as the impact of AI on personalized learning, engagement, academic support, and overall satisfaction. In the context of this study, the Cronbach’s Alpha value assures that the findings related to AI’s role in education are well-supported by a robust and reliable data collection tool, lending confidence to the interpretation of the results.

Figure 1: Description of AI impact with different factors

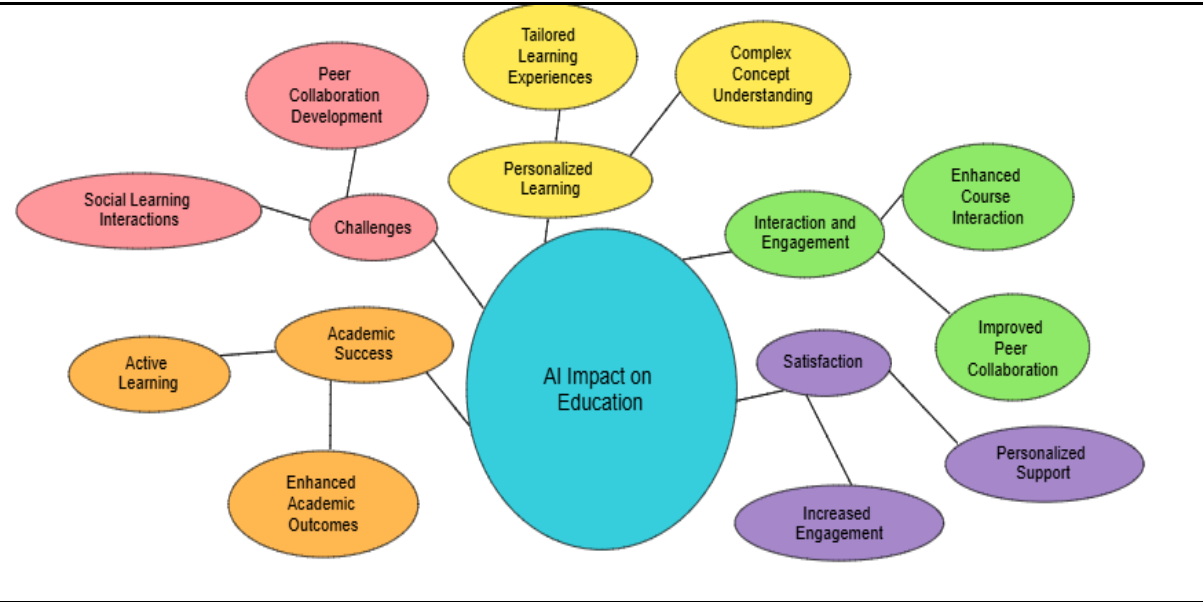


Figure 1 provides a comprehensive analysis of the impact of Artificial Intelligence (AI) on various aspects of education, with a particular focus on personalized learning experiences and student engagement. AI significantly enhances personalized learning by adapting educational content to individual student needs, learning styles, and progress, thereby improving the overall learning experience.

In online or distance education settings, AI-driven tools foster improved interaction, engagement, and collaboration among students by offering real-time feedback, virtual discussion platforms, and intelligent tutoring systems. Furthermore, the use of AI in providing personalized academic support, such as tailored recommendations for learning resources and assistance in overcoming specific challenges, has proven highly effective in expanding access to quality education. These advancements collectively influence students’ satisfaction with their learning journey, as AI-powered systems make education more accessible, engaging, and aligned with their goals and capabilities.

Table 6: Percentage of Responses

Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
AI tools have helped me personalize my learning experience based on my individual needs and preferences.	0.0%	4.0%	10.1%	58.6%	27.3%
The use of AI in education has enhanced my understanding of complex concepts and topics.	0.0%	19.2%	0.0%	65.7%	15.2%
AI technologies have provided me with personalized feedback to improve my academic performance.	0.0%	12.1%	13.1%	58.6%	16.2%
I feel more motivated to learn and engage with course materials due to the personalized support from AI.	0.0%	13.1%	24.2%	45.5%	17.2%
AI has helped me set and achieve personalized learning goals effectively.	7.1%	10.1%	23.2%	52.5%	7.1%
The use of AI has improved my overall academic performance and learning outcomes.	7.1%	16.2%	20.2%	52.5%	4.0%
AI tools have facilitated a more personalized and adaptive learning experience for me.	7.1%	8.2%	23.5%	57.1%	4.1%
I believe that AI has positively impacted my ability to learn and retain information.	3.0%	17.2%	9.1%	59.6%	11.1%
The use of AI has enhanced my personalized learning journey in a significant way.	0.0%	2.2%	29.7%	56.0%	12.1%
AI tools have enhanced my interaction with course materials and content.	0.0%	14.1%	14.1%	62.6%	9.1%
The use of AI has increased my engagement in online learning activities.	0.0%	9.1%	30.3%	48.5%	12.1%
AI technologies have improved my ability to interact with classmates and instructors in virtual settings.	0.0%	19.2%	36.4%	44.4%	0.0%
I feel more engaged in my learning process due to the personalized recommendations and feedback provided by AI.	0.0%	22.2%	29.3%	44.4%	4.0%
AI has positively impacted my overall level of interaction and engagement in educational tasks.	0.0%	18.2%	28.3%	51.5%	2.0%
The use of AI has made learning more interactive and engaging for me.	0.0%	10.1%	32.3%	51.5%	6.1%
I believe that AI tools have helped me collaborate more effectively with peers on academic projects.	0.0%	10.1%	30.3%	59.6%	0.0%
AI has encouraged me to participate more actively in discussions and group activities.	0.0%	21.2%	28.3%	47.5%	3.0%
AI tools have provided me with personalized academic support tailored to my individual learning needs.	0.0%	4.0%	23.2%	61.6%	11.1%
The use of AI has improved my access to resources and materials that support my academic learning.	0.0%	3.0%	18.2%	72.7%	6.1%
AI technologies have helped me better understand complex academic concepts and topics.	9.1%	10.1%	15.2%	60.6%	5.1%
I feel more confident in my academic abilities due to the assistance and support provided by AI.	0.0%	6.1%	40.4%	43.4%	10.1%

The use of AI has made it easier for me to seek help and assistance with academic challenges.	6.1%	8.2%	19.4%	65.3%	1.0%
AI tools have helped me stay organized and on track with my academic responsibilities.	6.1%	17.2%	32.3%	44.4%	0.0%
The use of AI in my academic experience has enhanced my overall satisfaction with the learning process.	0.0%	5.1%	17.2%	71.7%	6.1%
AI tools have improved my overall satisfaction with the level of support and assistance available to me as a student.	0.0%	5.1%	18.2%	70.7%	6.1%
The personalized feedback and recommendations provided by AI have increased my overall satisfaction with my academic performance.	0.0%	5.1%	32.3%	56.6%	6.1%
AI technologies have positively impacted my overall satisfaction with the level of engagement and interaction in my educational tasks.	0.0%	13.1%	29.3%	51.5%	6.1%
The convenience and accessibility of AI tools have contributed to my overall satisfaction with my academic journey.	0.0%	8.1%	14.1%	69.7%	8.1%
I believe that AI has played a significant role in improving my overall satisfaction with my academic progress and achievements.	0.0%	11.1%	15.2%	65.7%	8.1%

Figure 2. Student perceptions of AI's impact across key learning dimensions

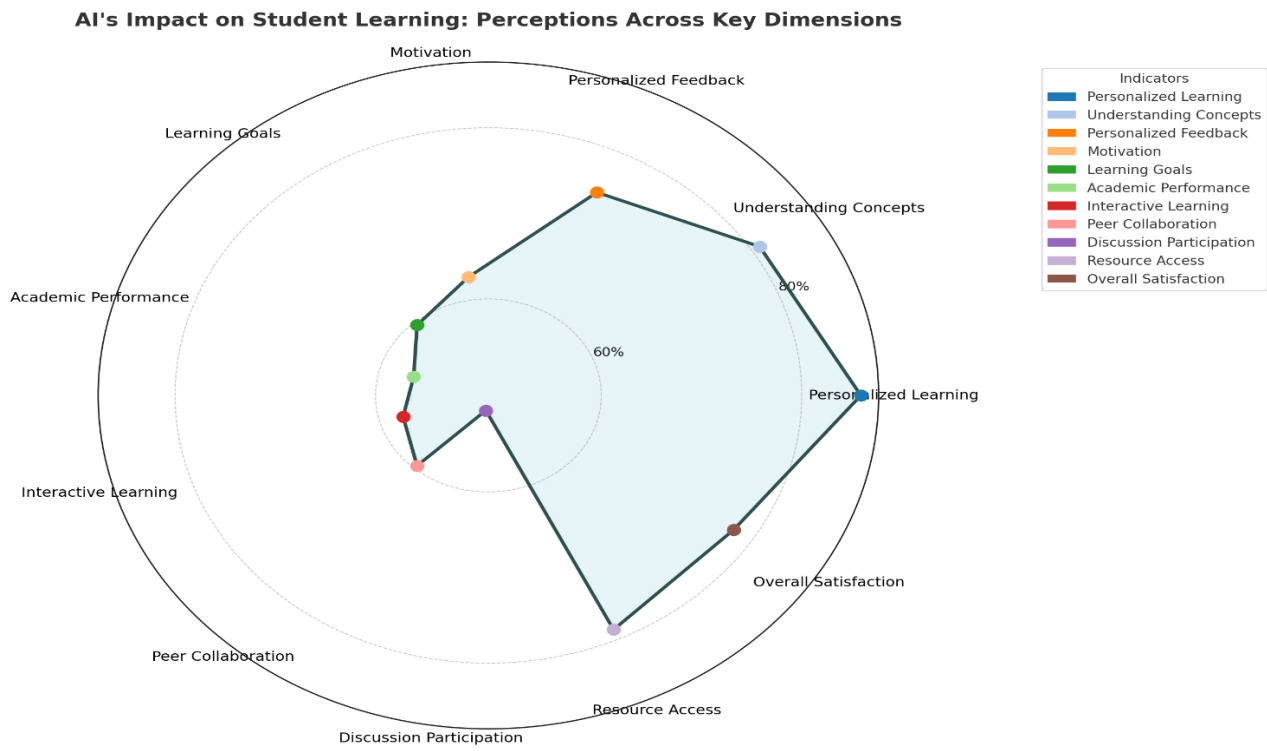


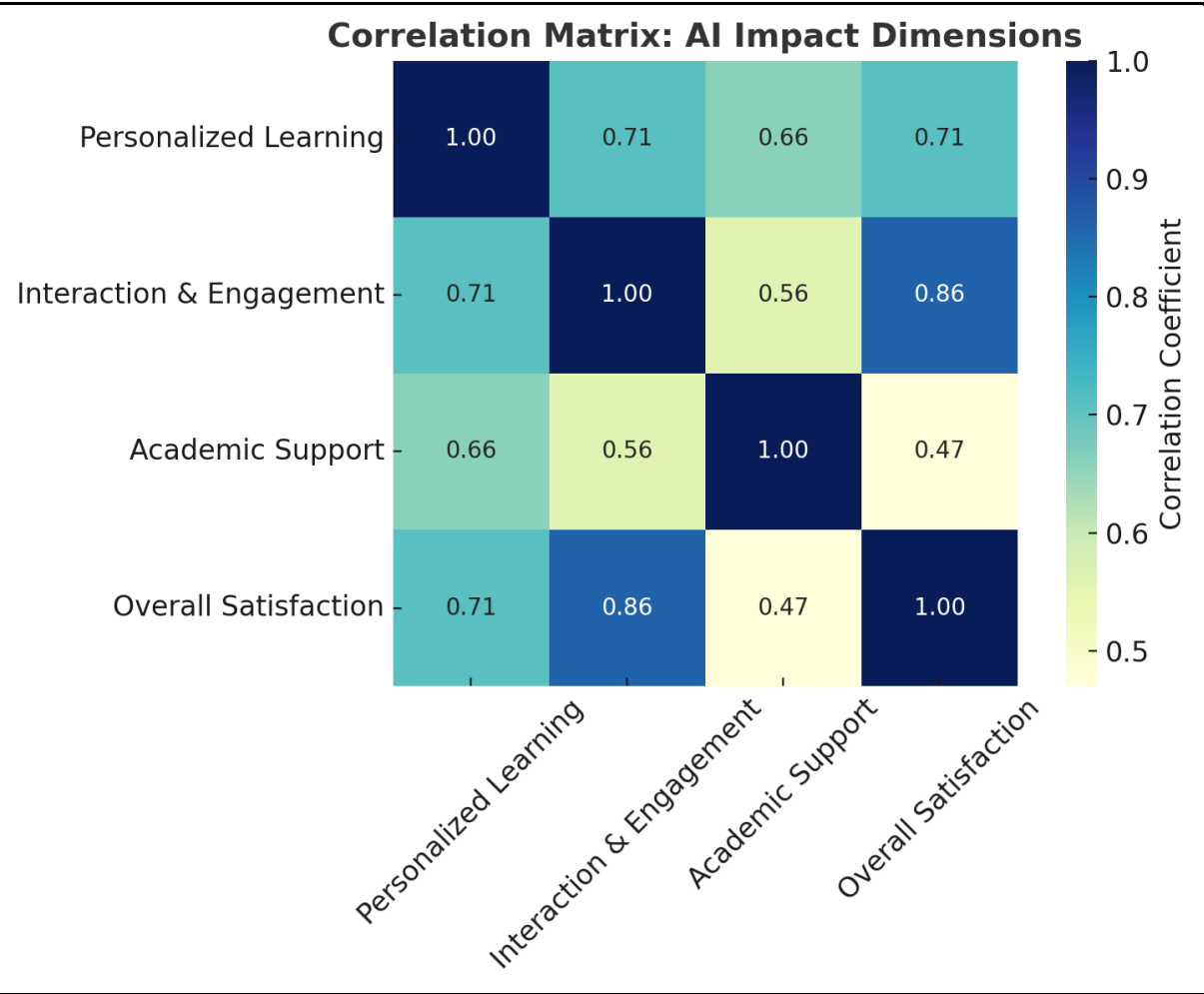
Table 6 and figure 2 explored the AI's role in personalizing learning experiences is strongly validated by the data, with 85.9% of respondents agreeing or strongly agreeing that AI tools cater to their individual needs. Similarly, over 59% believe AI helps them set and achieve personalized learning goals, though a small percentage expressed neutrality or disagreement, indicating potential gaps in this functionality. A notable 80.9% agreed that AI enhances their

understanding of complex concepts, supporting the findings from the literature review that AI significantly improves learning outcomes and provides adaptive support.

In terms of engagement and interaction, 71.7% of participants reported that AI tools have increased their engagement with course materials, demonstrating AI’s ability to foster active learning. However, only 59.6% agreed that AI enhances collaboration with peers, and 44.4% felt that AI improved virtual interactions with instructors and classmates. This suggests that while AI has made strides in promoting engagement, its impact on collaborative and social learning elements remains an area for further development.

The data also emphasizes AI’s contribution to academic support and overall satisfaction. About 74.8% of participants agree that AI provides tailored feedback to improve academic performance, and 78.8% attribute improvements in their academic performance to the use of AI technologies. Overall satisfaction with the learning journey, enhanced by AI, was reported by 77.8% of participants. These findings strongly align with the literature, which highlights AI’s potential to transform education through intelligent tutoring systems and personalized support.

Figure 3: Correlation analysis of the Factors



The analysis of the correlations among the four variables in the Figure reveals important insights into the impact of AI on educational experiences. The Impact of AI on Personalised Learning shows strong positive relationships with Student Interaction and Engagement ($r = 0.706$), Academic Support and Engagement ($r = 0.661$), and Overall Student Satisfaction ($r = 0.709$). This indicates that the ability of AI to tailor learning experiences to individual needs

significantly enhances students' interactions, engagement, and overall satisfaction. Similarly, Student Interaction and Engagement have the strongest correlation with Overall Student Satisfaction ($r = 0.860$), highlighting that AI-driven opportunities for interaction and engagement are the most influential factors in shaping students' satisfaction. It is also moderately correlated with Academic Support and Engagement ($r = 0.564$), suggesting that AI's support capabilities positively contribute to these areas as well. On the other hand, Academic Support and Engagement shows a weaker, though still significant, correlation with Overall Student Satisfaction ($r = 0.467$), suggesting that its effects are less pronounced compared to interaction and engagement. These findings emphasise that while all three areas—personalised learning, interaction and engagement, and academic support—are positively associated with student satisfaction, engagement and interaction have the most substantial impact, followed by personalised learning opportunities.

Findings

This study aimed to investigate the multifaceted impact of Artificial Intelligence (AI) on personalised learning, student engagement and interaction, academic support, and overall satisfaction within online and distance learning environments. The findings provide compelling evidence that integrating AI technologies significantly enhances various dimensions of the learning experience, effectively meeting the core objectives outlined in this research.

The primary objective was to investigate the impact of AI on students' personalised learning experiences. The study found that 85.9% of participants agreed or strongly agreed that AI tools have helped them personalise their learning journey according to their individual needs and preferences. This demonstrates that AI technologies—particularly adaptive learning platforms and intelligent tutoring systems—are successfully enabling the creation of tailored learning paths. Such personalisation not only facilitates comprehension of complex academic content but also empowers students to take ownership of their learning process, thereby improving motivation and performance. These findings align with previous research, which affirms that personalisation is one of the most powerful features of AI in education (Das et al., 2023; Kamalov et al., 2023).

The second research objective focused on analysing the role of AI in increasing student engagement and interaction in virtual settings. The results indicate that 71.7% of respondents felt more engaged with the course content due to the use of AI-driven tools. Additionally, 51.5% reported that learning became more interactive and meaningful. However, when it comes to interaction with peers and instructors, the findings were slightly less optimistic. Only 44.4% acknowledged improvement in communication with instructors, and 59.6% agreed that AI helped them collaborate more effectively with classmates. These insights reveal that while AI excels in enhancing content-based engagement, its capacity to foster real-time human interaction and collaborative learning is still evolving. Thus, the study not only confirms the positive influence of AI on individual engagement but also highlights an area for further development—designing AI systems that better support peer-to-peer and instructor-student collaboration.

The third objective aimed to investigate the effectiveness of AI in providing academic support specific to student needs. The data show that 74.8% of participants believe AI technologies have provided them with meaningful, personalised academic support, including timely feedback and access to tailored learning resources. This suggests that AI is instrumental in creating supportive learning environments where students can readily seek assistance and improve their academic standing. Notably, the study found that students feel more confident and better prepared to meet academic demands when AI-driven support is available, echoing findings in prior research that emphasise AI's role in enhancing learner autonomy and academic success (Hussain et al., 2022).

The ultimate objective was to evaluate students' overall satisfaction with their AI-supported learning experience. Here again, the study found strong evidence of a positive impact: 77.8% of students expressed satisfaction with their learning experience, citing ease of access, personalised support, and improved performance as key contributors. The correlation analysis further strengthened this conclusion, revealing strong and statistically significant relationships between personalised learning, engagement, academic support, and student satisfaction. Notably, student engagement and interaction emerged as the most influential predictors of overall satisfaction ($r = 0.860$), followed by personalised learning ($r = 0.709$). These results confirm that AI makes a meaningful contribution to creating a satisfying and enriching academic environment for online learners.

Conclusion

This study provides robust evidence of the significant role Artificial Intelligence (AI) plays in enriching personalised learning, fostering student engagement, enhancing academic support, and improving overall satisfaction in online and distance education environments. The results demonstrate that AI technologies are transforming learning experiences by making them more adaptive, learner-centred, and efficient.

A majority of participants (85.9%) affirmed that AI tools effectively addressed their individual learning needs, while 80.9% acknowledged the role of AI in helping them understand complex academic concepts. These findings validate AI's potential to personalise content and provide targeted support, enabling students to learn more effectively. Furthermore, 59% of students reported that AI helped them set and achieve individualised academic goals, further emphasising AI's contribution to self-directed learning.

In terms of engagement, 71.7% of students felt more connected to their learning materials through AI integration, suggesting that AI facilitates meaningful and active participation. However, while 59.6% agreed that AI supports peer collaboration and only 44.4% noted improved interaction with instructors, it is evident that AI's capacity to support social and collaborative learning remains an area requiring further development.

The impact of AI on academic support was also evident, with 74.8% of students acknowledging personalised feedback from AI tools and 78.8% attributing their academic improvements to AI-driven assistance. These contributions were strongly linked to overall satisfaction, which 77.8% of respondents reported as being positively influenced by AI-enhanced learning environments. The correlation analysis reinforced these observations, revealing strong positive associations between personalised learning, engagement, and overall satisfaction. Notably, student engagement showed the highest correlation with satisfaction ($r = 0.860$), followed by personalised learning ($r = 0.709$), indicating that AI's influence is most profound when it actively involves learners in the process.

In conclusion, the integration of AI into education is shown to be a transformative force. It enhances personalisation, boosts engagement, and provides meaningful academic support. While these benefits are substantial, further refinement is needed to optimise AI's role in promoting collaboration and communication among learners and instructors. Continued research and innovation in these areas will be essential to fully realise AI's potential in creating inclusive, engaging, and effective learning environments.

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