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The Impact of Artificial Intelligence on Academic Performance of Junior High School Students in China

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Abstract

This study investigates the impact of artificial intelligence (AI) applications on the academic performance of junior high school students in China. Specifically, it examines students' perceptions, cognitive understanding, practical usage, and ethical considerations related to AI, as well as individual differences such as gender and family background. A questionnaire survey was conducted among students in the first and third grades of a junior high school. The findings reveal that students' cognition and usage of AI do not significantly influence academic performance. However, students with a stronger awareness of AI ethics tend to achieve higher mathematics scores, with this effect being more pronounced among third-grade students. Moreover, students from households equipped with computers generally performed better academically, while ownership of tablets did not show a significant correlation with academic outcomes. Gender also emerged as a significant factor, with results suggesting that female students may face greater distractions from social media. This study underscores the importance of ethical considerations in AI education and recommends that educators and parents guide students to utilize AI tools for educational purposes while fostering a strong sense of AI ethics.

Keyword: Artificial Intelligence, Academic Performance, Educational Strategies, Junior High School Students

Introduction

With the rapid advancement of technology, artificial intelligence (AI) has increasingly permeated the field of education, presenting both opportunities and challenges for mathematics instruction (Hwang & Tu, 2021; Zreik, 2024). Its influence on students' academic outcomes has drawn significant scholarly attention. Applications of AI in mathematics education are becoming widespread, including intelligent tutoring systems and personalized learning platforms (Alrakhawi et al., 2023; Awang et al., 2025). These tools can tailor instructional support to individual learning needs, thereby enhancing both learning efficiency and effectiveness.

Recognizing the potential of AI in transforming education, the Chinese government and local authorities have issued a series of policies to encourage its integration into teaching and learning (Liu & Dunne, 2009; Xue et al., 2021). Nevertheless, the widespread implementation of AI technologies in educational contexts has also raised concerns regarding their actual impact on student academic performance. Some studies have reported that AI contributes positively to learning by analyzing students' homework, assessments, and behavior to identify areas of weakness and provide targeted resources. AI systems can also dynamically adjust question difficulty based on student proficiency, supporting adaptive learning and increasing engagement (Gligorea et al., 2023; Naseer & Khawaja, 2025; Strielkowski et al., 2025). Additionally, AI enables students to explore the practical applications of mathematical concepts, linking abstract theories to real-world scenarios and enhancing motivation. Real-time question-answering functions offered by AI tools further satisfy student curiosity and promote active inquiry (SugunaSri et al., 2024).

Conversely, other studies have highlighted potential drawbacks. For instance, students may become overly reliant on AI-generated answers, which can undermine their ability to independently analyze and solve problems (Adiyono et al., 2025; Zhai et al., 2024b). Prolonged dependence on AI tools may impair students' critical thinking and logical reasoning skills (Fan et al., 2025; Zhai et al., 2024a). These concerns mirror those related to excessive social media use, which may similarly affect cognitive development in Chinese adolescents.

Despite the growing body of research on the relationship between AI and academic performance, existing studies exhibit several limitations. Most prior research has focused on higher education or general educational contexts, with limited empirical data on junior high school students. Moreover, few studies have examined the comprehensive interplay between students' cognitive development, psychological adjustment, and socio-economic equity in the context of AI usage. Individual differences—such as gender, age, and family background—may moderate the effects of AI and social media on academic performance, yet these variables remain underexplored in current literature. To address these gaps, the present study aims to assess the relationship between AI-related competencies and academic performance among junior high school students in China, while examining how individual differences shape this relationship.

The contribution of this study is as follows: (1) While numerous studies have investigated the effects of AI on student learning, systematic research specifically focusing on Chinese junior high school students remains scarce. This study provides empirical insights into the relationship between AI usage and academic performance within this demographic; (2) By incorporating variables such as gender and family environment, the study offers a nuanced analysis of the moderating mechanisms underlying the AI–performance relationship; (3) These findings contribute to a broader understanding of adolescent development in the digital age and offer implications for the ethical and educational integration of AI technologies in secondary education.

Literature Review

Artificial Intelligence

Artificial Intelligence (AI) refers to the ability of computer systems or machines to perform tasks that typically require human intelligence, such as learning, reasoning, problem-solving,

and decision-making (Pannu, 2015; Sajja & Sajja, 2021). In education, AI encompasses technologies such as intelligent tutoring systems, adaptive learning platforms, automated assessment tools, and educational chatbots (Alrakhawi et al., 2023). These tools aim to enhance learning by providing personalized support, real-time feedback, and data-driven insights (Aggarwal, 2023).

AI in education operates through algorithms that analyze student behavior, predict performance, and adapt content to suit individual needs (Chen et al., 2020; Demartini et al., 2024). Key features include interactivity, adaptivity, and scalability, making AI tools particularly suitable for addressing diverse learning styles and gaps in large student populations. In China, AI in education has received strong policy support, with national strategies encouraging the integration of intelligent technologies into teaching and learning, especially in primary and secondary schools (Chan, 2023; Karan & Angadi, 2025; Wang & Luo, 2025).

Academic Performance

Academic performance refers to a student's achievement in educational tasks, typically measured by grades, test scores, and other formal assessments (Sadler, 2009; Vermunt, 2005). It reflects cognitive development and is a primary indicator of learning outcomes. Academic performance is influenced by both internal factors (such as motivation, cognitive ability, and learning strategies) and external conditions (such as family background, school resources, and teacher quality). Academic performance plays a critical role in determining students' educational trajectories due to the examination-oriented system. Junior high school marks a pivotal stage, as students prepare for the high school entrance examination, which heavily influences their future academic and career opportunities (Ghaleb, 2024; Lin & Liou, 2019).

Existing literature identifies multiple determinants of academic performance. Al-Sheeb et al. (2019) classify these into cognitive and non-cognitive predictors, emphasizing the role of self-regulated learning, time management, and academic self-efficacy. In recent years, technological factors—especially the use of educational technology and AI—have also attracted attention.Studies have shown that digital tools can support academic achievement by promoting engagement and offering individualized learning paths (Fokkens-Bruinsma et al., 2021). For example, AI-based learning platforms have been found to improve mathematics and reading scores in middle school students. However, these outcomes are often moderated by students' technological access and the effectiveness of teacher integration (Molnár & Kocsis, 2024).

Artificial Intelligence and Academic Performance

At present, there are divergences in the research on the relationship between artificial intelligence and academic performance. Some studies suggest that the use of artificial intelligence in education has many significant advantages. For instance, artificial intelligence demonstrates good system usability and receives positive feedback from students who use it to solve problems (Hooda et al., 2022). Additionally, artificial intelligence's ability to create personalized learning experiences, which adapt to the learning speed and style of individual students (Pyae et al., 2023), enriches students' educational journey by enhancing motivation, participation, and better information retention (Zhai & Wibowo, 2023). However, some

studies indicate that the educational functions of artificial intelligence may have a negative impact on academic performance. Some experts claim that students report quality issues in the output when using ChatGPT to locate problems, which may lead to errors and biases in generated answers (Chiu et al., 2024). Students may overly rely on artificial intelligence tools, resulting in a reduction in the emphasis on critical thinking and the investigation of alternative viewpoints (McLaren et al., 2010). Moreover, the implementation of ChatGPT raises data privacy and ethical issues, such as academic integrity, misinformation, deception, and privacy concerns (Kosch et al., 2023). It is worth noting that most studies focus on the university student population, while junior high school students are at a critical period of cognitive and social development and may have different usage behaviors and mechanisms.

Although the popularity of artificial intelligence in the learning process of teenagers has been continuously increasing, systematic research specifically targeting junior high school students is still scarce. The junior high school stage (12 to 15 years old) is a crucial period for the formation of teenagers' self-regulation abilities and learning habits. However, existing literature pays insufficient attention to this aspect. For instance, Othman, Bhutoria (2022) 's research focused on primary school students, but the researchers sampled from Saudi Arabia and did not conduct targeted analyses on China's unique artificial intelligence education system and its cultural background. Additionally, most existing studies analyze the impact of artificial intelligence on academic performance by examining its advantages and weaknesses, but they overlook the specific connections between artificial intelligence and students' academic performance as well as the moderating effects that individual differences may bring about. Ma et al. (2024) 's research compared gender differences in learning outcomes of artificial intelligence or perceptions of artificial intelligence-driven systems (such as robots), but this aspect has not been fully explored yet.

Methodology

Sample and Data Collection

The subjects of this study are Chinese junior high school students. The reason for choosing this group as the research object is that they are at a crucial stage of academic development and are increasingly exposed to artificial intelligence education. Junior high school students usually range in age from 12 to 15. At this stage, their academic performance is influenced by various factors, including their usage of artificial intelligence in education.

Design a questionnaire named "The Impact of the Use of Artificial Intelligence on Junior High School Students' Academic Performance in Mathematics", which covers the basic personal information of students (gender, grade), their social media usage (self-evaluation, application degree, and awareness of ethical issues, etc.), academic performance in mathematics, and family environment. Through the setting of multi-dimensional questions, collect comprehensive data relevant to the research topic.

The structural validity of this artificial intelligence scale was examined through confirmatory factor analysis. The results indicated that although some fit indices were slightly below the evaluation standards, other indices met the evaluation standards, suggesting that the scale had good structural validity. Further analysis of the convergent validity and discriminant validity of the scale revealed significant correlations among the factor indicators of each index, indicating that the scale had good convergent validity. The square root of the average

variance explained value (AVE) of each factor indicator was greater than the correlation coefficient between the factor and other factor indicators of the same scale, indicating that the scale had good discriminant validity. This questionnaire conducted a detailed investigation of the situation of junior high school students' use of social media, covering aspects such as usage duration, frequency, and motivation. The above scales were all 4-point scales, where 1 indicated very inconsistent and 4 indicated very consistent. They were converted into percentage scale scores, with the lowest and highest scores of each dimension being 0 and 100 respectively.

Econometric Model

In this study, a linear regression model was constructed with academic performance variables as the dependent variable and variables related to artificial intelligence usage as the independent variables. The regression equation is as follows:

$$y_i = \beta_0 + \alpha_1 x_1 + \beta_i X_i + \varepsilon_i$$

$$y_i = \beta_0 + \alpha_2 x_2 + \alpha_3 x_3 + \alpha_4 x_4 + \beta_i X_i + \varepsilon_i$$

Among them, y_i is the dependent variable, including math scores; x_1 represents Self-evaluation by students on their own use of artificial intelligence, x_2 represents artificial intelligence cognition, x_3 represents artificial intelligence application, and x_4 represents artificial intelligence ethics. X_i represents control variables, including gender, only child, home computers and tablets, school location, etc. β_0 is the intercept term and ε_i is the error term.

Results and Analysis

Descriptive Analysis

In terms of academic performance, the average score of mathematics for the first-year junior high school students was 82.14 points; for the third-year junior high school students, the corresponding subject's average score was 81.89 points. The average score gap between the two grades was not significant. The evaluation of students' own usage of artificial intelligence can reflect to some extent their overall level of artificial intelligence in education. The overall level of artificial intelligence usage among the first-year junior high school students was not high, with an average score of 68.60 points (see Table 1). Among them, the score of the artificial intelligence cognition dimension was 67.85 points, the score of the artificial intelligence application dimension was 69.92 points, and the score of the artificial intelligence ethics dimension was 66.28 points. The information application of the first-year junior high school students was relatively good, but their performance in information ethics was slightly worse. The overall level of artificial intelligence usage among junior high school students was not high, with a score of only 67.62 (see Table 1). Among them, the score of the information cognition dimension was 67.92, the score of the information application dimension was 68.10, and the score of the information ethics dimension was 66.17. The information application of junior high school students was relatively good, but their performance in information ethics was slightly worse.

Table 1
Descriptive analysis results

Variate	The first-year students Sample	Mean	SD	The third-year students sample	Mean	SD
Math scores	130	82.14	7.15	126	81.89	17.95
Students' self-evaluation	130	68.60	16.14	127	67.62	15.80
AI cognition	130	67.85	19.44	127	67.92	18.39
AI application	130	69.92	18.34	127	68.10	17.61
AI ethics	130	66.28	14.01	127	66.17	14.08

Difference Analysis

Regarding the different impacts of family information environment on students' academic performance and artificial intelligence education, please refer to Table 2 and Table 3. The data show that students whose families have computers have significantly higher average scores in mathematics academic performance and various dimensions of artificial intelligence usage indicators compared to those whose families do not have computers. Students in the first grade of junior high school who have tablets have significantly higher average scores in mathematics academic performance, the comprehensive level of artificial intelligence usage, artificial intelligence cognition, artificial intelligence application, and artificial intelligence ethics compared to those whose families do not have computers. Meanwhile, students in the third grade of junior high school have significantly higher average scores in mathematics academic performance, the comprehensive level of artificial intelligence usage, artificial intelligence cognition, and artificial intelligence ethics compared to those without tablets, but there is no significant difference in the application of artificial intelligence.

In order to verify whether there is a significant correlation between the usage of social media and the academic performance of junior high school students in mathematics, a regression analysis was conducted on the overall sample. The adjusted R^2 values of each equation model ranged from 0.027 to 0.084, and passed the significance test at the 0.001 level. This indicates that all explanatory variables and control variables entering the equation can effectively explain 2.7% to 8.4% of the changes in the academic performance of junior and senior high school students in mathematics. The maximum variance inflation factor of each explanatory variable was 5.76, and the minimum was 1.74, suggesting that there is no significant multicollinearity problem among the independent variables. The result analysis shows that only artificial intelligence ethics has a significant positive impact on their academic performance. Meanwhile, among other control variables, gender, family information environment, etc., have a significant impact on their academic performance.

Table 2
Comparison of differences of the first-grade students

Variate		Home computer		T	Tablet computer		T
		No	Yes		No	Yes	
Math grade		80.77	83.30	-14.54***	81.70	82.35	-4.11***
AI	General proficiency	66.05	69.73	-12.04***	67.50	69.69	-7.71***
	AI cognition	64.91	69.15	-11.44***	66.39	69.28	-8.48***
	AI application	67.32	71.07	-10.77***	68.78	71.03	-7.02***
	AI ethics	64.17	67.22	-11.72***	65.56	66.99	-5.86***

Table 3
Comparison of differences of the third-grade students

Variate	Home computer		T	Tablet computer		T
	No	Yes		No	Yes	
Math grade	78.41	83.29	-13.83***	81.40	82.48	-3.34***
General proficiency	64.93	68.71	-12.31***	66.62	68.80	-8.79***
AI cognition	64.59	69.26	-13.08***	66.60	69.48	-8.83***
AI application	65.13	69.31	-12.20***	66.84	69.60	-1.66
AI ethics	64.32	66.93	-9.50***	65.99	66.40	-7.72***

The Impact of AI on Academic Performance

The regression estimation results of Equation 1 indicate that artificial intelligence can significantly improve the mathematics scores of junior high school students. After controlling for all variables, the impact of artificial intelligence education on the mathematics scores of first-year and third-year junior high school students decreased to 0.095 and 0.172 respectively, suggesting that the influence of artificial intelligence on the mathematics academic performance of junior high school students is not entirely caused by the artificial intelligence education itself. Mathematics scores are related to demographic characteristics and family information environment. The improvement effect of information education on the mathematics scores of third-year junior high school students is higher than that of the first-year junior high school students.

The results of the regression estimation of Equation 2 indicate that among the various dimensions of artificial intelligence education, artificial intelligence cognition and application have no significant impact on the academic performance of junior high school students, but artificial intelligence ethics can significantly improve their mathematics academic performance. After controlling for all variables, the impact of artificial intelligence ethics on the mathematics performance of junior high school students in the first grade has weakened to 0.160. The impact of artificial intelligence ethics on the mathematics performance of junior high school students in the third grade is also higher than that of primary school students. After controlling for all variables, the impact of artificial intelligence ethics on the mathematics performance of junior high school students in the third grade is 0.251.

Regarding the gender of students, after controlling for all variables, gender factors have a significant impact on the academic performance of junior high school students in the first

grade and the third grade, respectively, 0.411 and 1.110. Regarding the situation of having social media devices at home, the factor of having computers at home has a significant positive impact on the mathematics performance of junior high school students in the first grade and the third grade, respectively, 1.951 and 4.235. Meanwhile, the situation of having tablets at home has no significant impact on the mathematics academic performance of students. Apart from demographic characteristics and the ownership situation of electronic devices at home, the location of the family has no significant impact on the mathematics performance of students. The impact of artificial intelligence ethics on the mathematics performance of junior high school students in the third grade is higher than that of those in the first grade.

Table 4
The impact of AI on academic performance

Variate	The first-year students		The third-year students	
	Equation 1	Equation 2	Equation 1	Equation 2
Information education	0.095***		0.172***	
Information cognition		-0.002		-0.349
Information application		-0.013		0.030
Information ethics		0.160***		0.251***
Gender	0.263	0.411***	0.721*	1.110***
Home compute	2.042***	1.951***	4.265***	4.235***
Tablet computer	-0.285	-0.237	-0.465	-0.137
Urban/township	0.284	0.151	0.036*	-0.393
Intercept term	24.387***	21.310***	32.091***	27.248***
Sample	65	65	63	63
Adjusted R-Square	0.062	0.084	0.041	0.056
VIF	1.74	2.23	1.82	5.10

To sum up, the behaviors of junior high school students using artificial intelligence have varying degrees of influence on their academic performance. Among them, the cognition and application of artificial intelligence have no significant impact on the performance, while the ethics of artificial intelligence can significantly improve the performance. After controlling all variables, this influence has weakened to some extent. Among junior high school students, the impact of artificial intelligence ethics on mathematics performance is greater than that of freshmen. After controlling variables, this influence has also weakened. In addition, gender factors have a significant impact on students' academic performance. Having a computer at home has a significant positive impact on mathematics performance, while having a tablet has no significant impact on performance. The location of the family has no significant impact on the mathematics performance of junior high school students.

Discussion

Among junior high school students, this study found that students' understanding and application of artificial intelligence had no significant impact on their academic performance in mathematics. However, the ethical aspect of artificial intelligence could significantly and positively affect their academic performance. Moreover, the ethical aspect of artificial intelligence had a greater impact on junior high school students in the third grade than those in the first grade. Regarding the family information environment, the ownership rate of family computers could significantly improve academic performance, while the ownership rate of tablet computers had no significant impact. There was no significant difference in mathematics performance between junior high school students from urban or rural families. At the same time, gender was significantly correlated with academic performance.

The Relationship between AI and Academic Performance

Among junior high school students, there is no significant correlation between their understanding and application of artificial intelligence and their academic performance in mathematics. This might be because junior high school mathematics focuses on algebra, geometry, and arithmetic as its core subjects, while the underlying logic of AI relies on advanced mathematics (such as linear algebra, probability statistics) and programming thinking. There is a clear gap in knowledge levels between these two areas. Junior high school students' understanding of AI is mostly limited to application scenarios (such as voice assistants, image generation) rather than technical principles, lacking the cognitive awareness of mathematical connections. AI applications (such as generating content by calling APIs) rely more on operational proficiency rather than mathematical deduction abilities. Students may complete tasks through "black box operations" without involving mathematical knowledge. AI applications are mostly result-oriented (such as generating images, dialogues), while mathematical abilities rely on systematic logical training. There are differences in cognitive load types between them (intuitive operation vs. rigorous reasoning).

AI Ethics and Academic Performance in Mathematics

The ethical considerations of artificial intelligence have a significant positive impact on students' academic performance in mathematics. Students' understanding and application of artificial intelligence have no significant influence on their academic performance. This indicates that the new curriculum standards in China emphasize the social responsibility of mathematics (such as privacy protection awareness in data analysis), and teachers may trigger ethical discussions by using cases (such as the information cocoon created by social media algorithm recommendations), thereby indirectly strengthening the connection between mathematics and ethics. At the same time, this might also be because students with a stronger foundation in mathematics are more likely to realize the limitations of technology (such as questioning the confidence of AI assessment results through statistical knowledge) earlier, and then actively pay attention to ethical issues.

Individual Differences

In terms of the extent to which artificial intelligence affects students' academic performance, its impact on junior high school students in grade 9 (senior grade 3) is significantly greater than that on junior high school students in grade 7 (senior grade 2). This might be because senior grade students are better at using artificial intelligence for deep learning. The effect on grade 9 students is stronger, which is likely due to their entry into the formal operational

stage of Piaget's cognitive theory, enabling them to perform hypothetical reasoning, abstract concept understanding, and systematic logical analysis, which are crucial for handling complex trade-offs in AI ethics (such as privacy protection and technological innovation). In contrast, grade 7 students are in the adaptation stage, relying on concrete things for thinking and finding it difficult to understand abstract ethical concepts like "algorithm bias" and "data ownership". In terms of family conditions, the ownership rate of family computers can significantly improve students' math scores. This might be because computers support more efficient AI education.

Meanwhile, the ownership rate of tablets has no significant impact on academic performance, possibly because they have a higher proportion of entertainment functions. Family computers provide stable technical support for students, facilitating systematic learning (such as completing online assignments and consulting materials), while tablets are more often used in fragmented entertainment scenarios, having a relatively smaller impact on academic performance. In terms of family location, students' math scores are not affected. This might be related to the fact that math scores are more influenced by standardized courses. In terms of gender, gender is significantly correlated with academic performance. The gender variable has a significant impact on academic performance, which might reflect that during junior high school, girls face greater pressure from social interference (such as higher social interaction needs) or other gender-related factors (such as self-efficacy) that are not controlled in the study.

Conclusion

This study conducted an in-depth analysis of how artificial intelligence (AI) usage and individual differences influence the mathematics academic performance of junior high school students in China, offering a multi-dimensional perspective on learning development at this educational stage. The findings indicate that students' cognition and application of AI technologies are not significantly associated with academic outcomes, whereas students' awareness of AI ethics plays a key role in improving academic performance. This highlights the central role of ethical literacy in AI-assisted learning and suggests that educators and parents should actively guide students in developing a sound ethical understanding of AI to foster more effective and responsible learning behaviors.

Notably, the impact of AI ethics on academic performance was more pronounced among third-grade students compared to those in the first grade. While tablets offer portability and convenience, they often contain a high proportion of entertainment applications, which can distract students with games and videos, thereby diminishing their contribution to academic improvement. Gender also emerged as a significant factor influencing academic performance. The findings suggest that junior high school girls may face greater social distractions or pressures, possibly due to stronger social needs that lead to frequent engagement on social media—such as replying to messages and participating in discussions—at the expense of study time and focus.

Despite its contributions, this study has several limitations. First, regarding research methodology, the explanatory power of the statistical model was relatively low (R^2 = 2.7%–8.4%), and key variables such as students' cognitive ability and the quality of instruction were not included. The cross-sectional design also prevents causal inference. There may be

bidirectional influences between AI ethics and academic performance—for instance, higher-achieving students may be more inclined to engage with ethical issues. Furthermore, several potential influencing variables, such as study habits and school quality, were not fully considered. Students with strong study habits—such as effective planning and knowledge summarization—may perform well regardless of their use of learning technologies. Differences in school resources, teaching philosophies, and infrastructure can also significantly impact student outcomes, but these factors were not adequately addressed, potentially leading to biases in the findings. Additionally, the sample selection may have limitations in representativeness, restricting the generalizability of the findings to students from diverse regions and socioeconomic backgrounds. Variations in access to educational resources, family emphasis on education, and patterns of social media use across regions could further influence students' academic performance, suggesting that the conclusions drawn may not be universally applicable.

To gain a more comprehensive understanding of the factors influencing junior high school students' performance in mathematics, future research should adopt a multidimensional approach. First, the scope of research variables should be expanded to include students' learning habits, the educational environment of their schools, and parenting styles at home. Exploring these factors can inform the development of targeted educational strategies. Second, gender-related mechanisms should be examined in greater depth through longitudinal studies. Tracking students' development over time through periodic surveys and interviews—combined with behavioral analyses of social media usage, including time management, platform preferences, and psychological motivations—can help uncover the underlying causes of gender differences in academic performance. Finally, intervention-based research is recommended. Designing integrated online and offline training programs that teach students how to use AI tools to access high-quality educational resources, as well as skills in time management and efficient learning methods, may prove valuable. By comparing the academic outcomes and learning motivation of students in experimental and control groups before and after such interventions, researchers can evaluate the effectiveness of the programs. Based on these evaluations, continuous refinement of educational strategies can be undertaken to offer practical recommendations for improving student performance and promoting academic development among junior high school students.

References

Adiyono, A., Suwartono, T., Nurhayati, S., Dalimarta, F. F., & Wijayanti, O. (2025). Impact of artificial intelligence on student reliance for exam answers: A case study in IRCT Indonesia. *International Journal of Learning, Teaching and Educational Research*, *24*(3), 519-544.

Aggarwal, D. (2023). Integration of innovative technological developments and AI with education for an adaptive learning pedagogy. *China Petroleum Processing and Petrochemical Technology*, *23*(2), 709-714.

Al-Sheeb, B. A., Hamouda, A., & Abdella, G. M. (2019). Modeling of student academic achievement in engineering education using cognitive and non-cognitive factors. *Journal of Applied Research in Higher Education*, *11*(2), 178-198.

Alrakhawi, H. A., Jamiat, N., & Abu-Naser, S. S. (2023). Intelligent tutoring systems in education: a systematic review of usage, tools, effects and evaluation. *Journal of Theoretical and Applied Information Technology*, *101*(4), 1205-1226.

Awang, L. A., Yusop, F. D., & Danaee, M. (2025). Current practices and future direction of artificial intelligence in mathematics education: A systematic review. *International Electronic Journal of Mathematics Education*, *20*(2), em0823.

Bhutoria, A. (2022). Personalized education and artificial intelligence in the United States, China, and India: A systematic review using a human-in-the-loop model. *Computers and Education: Artificial Intelligence*, *3*, 100068.

Chan, C. K. Y. (2023). A comprehensive AI policy education framework for university teaching and learning. *International journal of educational technology in higher education*, *20*(1), 38-50.

Chen, Z., Zhang, J., Jiang, X., Hu, Z., Han, X., Xu, M., & Vivekananda, G. (2020). Education 4.0 using artificial intelligence for students performance analysis. *Inteligencia Artificial*, *23*(66), 124-137.

Chiu, T. K., Moorhouse, B. L., Chai, C. S., & Ismailov, M. (2024). Teacher support and student motivation to learn with Artificial Intelligence (AI) based chatbot. *Interactive Learning Environments*, *32*(7), 3240-3256.

Demartini, C. G., Sciascia, L., Bosso, A., & Manuri, F. (2024). Artificial intelligence bringing improvements to adaptive learning in education: A case study. *Sustainability*, *16*(3), 1347.

Fan, Y., Tang, L., Le, H., Shen, K., Tan, S., Zhao, Y., Shen, Y., Li, X., & Gašević, D. (2025). Beware of metacognitive laziness: Effects of generative artificial intelligence on learning motivation, processes, and performance. *British Journal of Educational Technology*, *56*(2), 489-530.

Fokkens-Bruinsma, M., Vermue, C., Deinum, J.-F., & van Rooij, E. (2021). First-year academic achievement: the role of academic self-efficacy, self-regulated learning and beyond classroom engagement. *Assessment & Evaluation in Higher Education*, *46*(7), 1115-1126.

Ghaleb, B. D. S. (2024). Effect of exam-focused and teacher-centered education systems on students' cognitive and psychological competencies. *International Journal of Multidisciplinary Approach Research and Science*, *2*(2), 611-631.

Gligorea, I., Cioca, M., Oancea, R., Gorski, A.-T., Gorski, H., & Tudorache, P. (2023). Adaptive learning using artificial intelligence in e-learning: A literature review. *Education Sciences*, *13*(12), 16-29.

Hooda, M., Rana, C., Dahiya, O., Rizwan, A., & Hossain, M. S. (2022). Artificial intelligence for assessment and feedback to enhance student success in higher education. *Mathematical Problems in Engineering*, *2022*(1), 5215722.

Hwang, G.-J., & Tu, Y.-F. (2021). Roles and research trends of artificial intelligence in mathematics education: A bibliometric mapping analysis and systematic review. *Mathematics*, *9*(6), 584-598.

Karan, B., & Angadi, G. (2025). Artificial intelligence integration into school education: A review of Indian and foreign perspectives. *Millennial Asia*, *16*(1), 173-199.

Kosch, T., Welsch, R., Chuang, L., & Schmidt, A. (2023). The placebo effect of artificial intelligence in human–computer interaction. *ACM Transactions on Computer-Human Interaction*, *29*(6), 1-32.

Lin, J. J., & Liou, P.-Y. (2019). Assessing the learning achievement of students from different college entrance channels: a linear growth curve modelling approach. *Assessment & Evaluation in Higher Education*, *44*(5), 732-747.

Liu, Y., & Dunne, M. (2009). Educational reform in China: Tensions in national policy and local practice. *Comparative Education*, *45*(4), 461-476.

Ma, D., Akram, H., & Chen, I.-H. (2024). Artificial Intelligence in Higher Education: a cross-cultural examination of students' behavioral intentions and attitudes. *International Review of Research in Open and Distributed Learning*, *25*(3), 134-157.

McLaren, B. M., Scheuer, O., & Mikšátko, J. (2010). Supporting collaborative learning and e-discussions using artificial intelligence techniques. *International Journal of Artificial Intelligence in Education*, *20*(1), 1-46.

Molnár, G., & Kocsis, Á. (2024). Cognitive and non-cognitive predictors of academic success in higher education: a large-scale longitudinal study. *Studies in Higher Education*, *49*(9), 1610-1624.

Naseer, F., & Khawaja, S. (2025). Mitigating Conceptual Learning Gaps in Mixed-Ability Classrooms: A Learning Analytics-Based Evaluation of AI-Driven Adaptive Feedback for Struggling Learners. *Applied Sciences*, *15*(8), 44-60.

Pannu, A. (2015). Artificial intelligence and its application in different areas. *Artificial Intelligence*, *4*(10), 79-84.

Pyae, A., Ravyse, W., Luimula, M., Pizarro-Lucas, E., Sanchez, P. L., Dorado-Diaz, I. P., & Thaw, A. K. (2023). Exploring user experience and usability in a metaverse learning environment for students: A usability study of the artificial intelligence, innovation, and society (AIIS). *Electronics*, *12*(20), 4283.

Sadler, D. R. (2009). Grade integrity and the representation of academic achievement. *Studies in Higher Education*, *34*(7), 807-826.

Sajja, P. S., & Sajja, P. S. (2021). Introduction to artificial intelligence. *Illustrated Computational Intelligence: Examples and Applications*, *7*(7), 1-25.

Strielkowski, W., Grebennikova, V., Lisovskiy, A., Rakhimova, G., & Vasileva, T. (2025). AI-driven adaptive learning for sustainable educational transformation. *Sustainable Development*, *33*(2), 1921-1947.

SugunaSri, S., Leelavathy, N., Kodi, R., & Sujatha, B. (2024). A Question Answering System Application Integrated with Chatbot Using NLP. *Indian Journal of Science and Technology*, *17*(29), 2972-2980.

Vermunt, J. D. (2005). Relations between student learning patterns and personal and contextual factors and academic performance. *Higher education*, *49*(7), 205-234.

Wang, Q., & Luo, J. (2025). Strategies for Improving the Quality of Secondary-School Ideological and Political Education in the Era of Artificial Intelligence. *International Journal of High Speed Electronics and Systems*, *9*(4), 2540708.

Xue, E., Li, J., Li, T., & Shang, W. (2021). China's education response to COVID-19: A perspective of policy analysis. *Educational Philosophy and Theory*, *53*(9), 881-893.

Zhai, C., & Wibowo, S. (2023). A systematic review on artificial intelligence dialogue systems for enhancing English as foreign language students' interactional competence in the university. *Computers and Education: Artificial Intelligence*, *4*, 100134.

Zhai, C., Wibowo, S., & Li, L. D. (2024a). The effects of over-reliance on AI dialogue systems on students' cognitive abilities: a systematic review. *Smart Learning Environments*, *11*(1), 28-42.

Zhai, C., Wibowo, S., & Li, L. D. (2024b). The effects of over-reliance on AI dialogue systems on students' cognitive abilities: a systematic review. *Smart Learning Environments*, *11*(1), 28-40.

Zreik, M. (2024). Redefining mathematics education in the age of artificial intelligence: Challenges and opportunities. *Impacts of globalization and innovation in mathematics education*, *8*(5), 19-40.