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The Impact of Artificial Intelligence on Cognitive Skills Development in Future Teachers

Abstract

Introduction. The study investigates the impact of Artificial Intelligence (AI), particularly ChatGPT, on the development of cognitive skills in future specialists. It explores how AI integration into higher education can enhance critical thinking, problem-solving abilities, and personalized learning while addressing ethical concerns such as academic integrity, technological dependence, and data privacy. **Methodology and Methods.** A mixed-methods approach was applied, combining qualitative and quantitative techniques. Data were collected from 148 third- and fourth-year students of the "Teaching and Primary Education Methodology" program through surveys, questionnaires, and semi-structured interviews. Statistical analyses, including t-tests and ANOVA, were employed to examine the effects of ChatGPT on students' cognitive activity, learning engagement, and perception of AI in education. **Results.** Findings indicate that ChatGPT significantly enhances students' analytical and problem-solving skills, promotes deeper comprehension of content, and increases engagement and motivation. A majority of students reported that AI enables personalized learning pathways, while a minority emphasized its role in monitoring academic progress. Identified challenges include ethical considerations, limited technical support, and data privacy concerns. Nevertheless, AI tools were generally perceived as beneficial for cognitive skill development and active learning. **Scientific novelty.** The study demonstrates that AI, when ethically integrated, fosters cognitive growth and critical thinking in future specialists. **Practical significance.** The results provide evidence-based recommendations for using AI in education, emphasizing responsible implementation to enhance learning quality, motivation, and individualized educational trajectories.

Keywords: AI, ChatGPT, cognition, university, personalization, engagement.

Introduction. The integration of artificial intelligence (AI) technologies, particularly ChatGPT, into education has introduced new opportunities for personalized learning, student engagement, and cognitive development. AI enables adaptive learning pathways that enhance analytical thinking, critical skills, and overall learning efficiency. It also supports the generation of educational materials, contributing to deeper understanding and improved knowledge acquisition (Seo et al., 2021; Bollaert, 2025; Deroncele-Acosta et

al., 2025). Studies emphasize that excessive dependence on AI tools such as ChatGPT may negatively affect independent learning and objectivity in academic assessment (Phua et al., 2025). Therefore, AI should complement rather than replace traditional teaching methods (Roe & Perkins, 2022; Sullivan et al., 2023; Paskova, 2023).

Methodologically, this study applies both qualitative and quantitative approaches. Data were collected through student surveys, and statistical analysis (t-tests and ANOVA) was

used to evaluate the impact of ChatGPT on academic performance. Respondents were divided into four groups based on language and educational background, and data were gathered using a 5-point Likert scale questionnaire. AI technologies, particularly generative systems like ChatGPT, have significantly transformed education by enabling real-time personalized feedback, adaptive learning, and improved problem-solving skills (Albadarin et al., 2024; Tsiatsos et al., 2021; Rane et al., 2023). These systems support individualized learning paths aligned with Education 4.0 and 5.0 models. Research shows that AI enhances critical thinking and cognitive engagement by providing immediate feedback and interactive learning support (Kukulska-Hulme & Shield, 2020; Haleem et al., 2022; Nasr et al., 2025; Deep & Chen, 2025). However, its effectiveness depends on the quality of interaction, particularly in higher-order thinking processes.

ChatGPT is widely used in education for generating content, answering questions, and supporting online learning environments. However, privacy risks remain a key concern, as large language models may expose sensitive data (Shahriar & Dara, 2025). Additionally, the quality of AI-generated feedback depends on prompt design (Jacobsen & Weber, 2025). Studies also show that ChatGPT positively influences student engagement and learning performance by providing instant feedback and supporting problem-solving skills (Kasneci et al., 2023; Pradana et al., 2023). In specialized fields such as computer science, AI integration has demonstrated improved academic outcomes (López-Fernández & Vergaz, 2024). Despite these benefits, AI cannot replace educators. It should be used as a supportive tool under proper regulatory and pedagogical frameworks (Fitria, 2021; Dwivedi, 2023). Effective integration requires balancing innovation with ethical responsibility, ensuring data privacy, fairness, and academic integrity (Akgun & Greenhow, 2021; Zhai et al., 2020; Zhai, 2023; Rachovski et al., 2024).

Recent studies highlight the growing role of artificial intelligence (AI) in education,

particularly in enhancing learning processes, cognitive development, and student engagement. Akgun and Greenhow (2021) emphasize ethical concerns, noting that excessive reliance on AI may weaken students' critical thinking and independent judgment. Similarly, Dwivedi et al. (2023) and Albadarin et al. (2024) stress that although AI offers significant educational benefits, it also raises issues related to academic integrity, algorithmic bias, and learner autonomy. In contrast, Haleem et al. (2022) and Kasneci et al. (2023) argue that AI tools such as ChatGPT can positively influence cognitive skills, improve academic performance, and support personalized learning when used appropriately. However, the effectiveness of AI depends on responsible integration and clear ethical guidelines, particularly regarding data use and content reliability (Zhou et al., 2024). Methodological trends in this field increasingly employ mixed methods approaches. Japoshvili-Ghvinashvili and Suleman (2023) demonstrate that combining quantitative and qualitative methods provides a more complete understanding of AI's impact on education by capturing both measurable outcomes and user experiences.

Based on this framework, the present study investigates the influence of AI technologies, particularly ChatGPT, on cognitive skills development among future specialists. The study focuses on 148 third- and fourth-year students (aged 22–23) from the “Teaching and Primary Education Methodology” program at the Kazakh National Women's Pedagogical University. The sample was divided according to language of instruction (Kazakh and Russian) to explore potential differences in perceptions within a multilingual educational context. Data were collected using questionnaires and semi-structured interviews. Quantitative data were analyzed using descriptive statistics, t-tests, and ANOVA, while qualitative data were examined through thematic and sentiment analysis. Structural equation modeling (SEM) was additionally considered to explore relationships between AI usage, engagement, and learning outcomes. Ethical standards were strictly observed, ensuring

informed consent, voluntary participation, and complete anonymity of respondents. Overall, this study aims to provide a concise but comprehensive understanding of how AI, particularly ChatGPT, influences cognitive development, academic engagement, and learning experiences in higher education.

Purpose of the study. The purpose of this study is to examine the impact of artificial intelligence (ChatGPT) technologies on the development of cognitive skills among future specialists in higher education, as well as to identify their effectiveness in the learning process and their influence on students' academic engagement and individualized learning pathways.

Materials and Methods. This study adopted a mixed-methods research design to investigate the impact of Artificial Intelligence (AI), particularly ChatGPT, on the development of cognitive skills among future specialists. The integration of quantitative and qualitative approaches allowed for a comprehensive analysis of both measurable patterns and in-depth perceptions of students regarding AI-supported learning. The quantitative component focused on examining statistical relationships between AI usage and academic indicators, while the qualitative component aimed to explore students' experiences, attitudes, and interpretations of AI in the educational process.

Participants. The participants of the study were 148 undergraduate students enrolled in the "Teaching and Primary Education Methodology" program at the Kazakh National Women's Pedagogical University in Almaty. All respondents were third and fourth-year students aged 22–23 years. The sample was purposefully selected due to the participants' sufficient academic background and prior experience with digital learning tools, which enabled them to critically evaluate the educational use of AI technologies. To explore potential differences in perception, the participants were divided into four groups based on the language of instruction (Kazakh and Russian), considering the multilingual and multicultural context of the educational environment in Kazakhstan.

Data collection instruments. Data were collected using multiple instruments to ensure methodological triangulation. A structured questionnaire based on a 5-point Likert scale was employed to measure students' perceptions of AI effectiveness, academic engagement, cognitive skill development, and learning motivation. The questionnaire included both closed-ended and open-ended questions, allowing the collection of both quantitative and qualitative data. In addition, semi-structured interviews were conducted with selected participants to obtain more detailed insights into their experiences with ChatGPT and other AI tools in educational settings. Supplementary qualitative observations were also considered to better understand the practical use of AI in academic activities.

Procedure. The data collection procedure was conducted in several stages. First, participants were informed about the purpose of the study and assured of confidentiality, anonymity, and voluntary participation. Second, questionnaires were administered both electronically and in paper format, depending on accessibility. Third, semi-structured interviews were conducted to deepen the understanding of emerging themes identified in the survey data. All collected data were anonymized before analysis in accordance with ethical research standards.

Data analysis technique. Data analysis was performed using both quantitative and qualitative techniques. Quantitative data were analyzed through descriptive statistics (frequency distributions and percentages) and inferential statistical methods, including independent-samples t-tests and one-way analysis of variance (ANOVA), to determine statistically significant differences between groups. A significance level of $p < 0.05$ was applied. Qualitative data obtained from open-ended survey responses and interviews were analyzed using thematic content analysis, focusing on key themes such as cognitive skill development, academic engagement, ethical considerations, and learner autonomy.

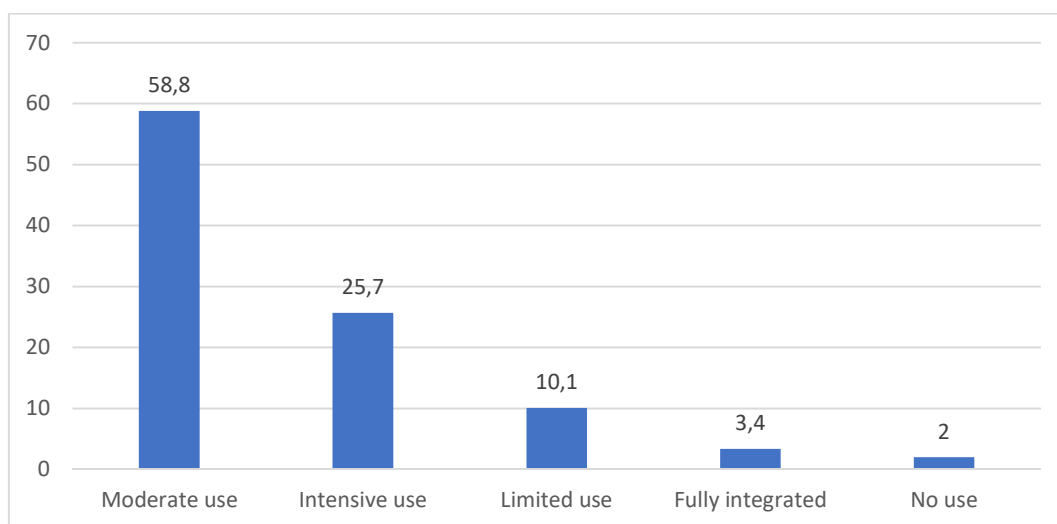
Ethical considerations were strictly observed throughout the study. Participation was voluntary, informed consent was obtained from

all respondents, and confidentiality was fully ensured. No personally identifiable information was used in the analysis or reporting of results. The study adhered to established ethical principles in educational research, including data protection and responsible handling of participant information. Overall, the methodological framework of this study integrates quantitative measurement with qualitative interpretation, enabling a robust evaluation of the role of ChatGPT and other AI tools in enhancing cognitive skills, academic engagement, and learning outcomes in higher education.

Results. The study involved 148 fourth-year students enrolled in the “Teaching and Primary Education Methodology” program at Kazakh National Women’s Teacher Training University. The purpose of the research was to examine students’ perceptions of artificial intelligence (AI) technologies and their implementation in inclusive educational practices. Data were collected using a five-point Likert scale questionnaire that assessed students’ attitudes toward AI integration, its effectiveness, cognitive benefits, implementation barriers, and recommendations for future use.

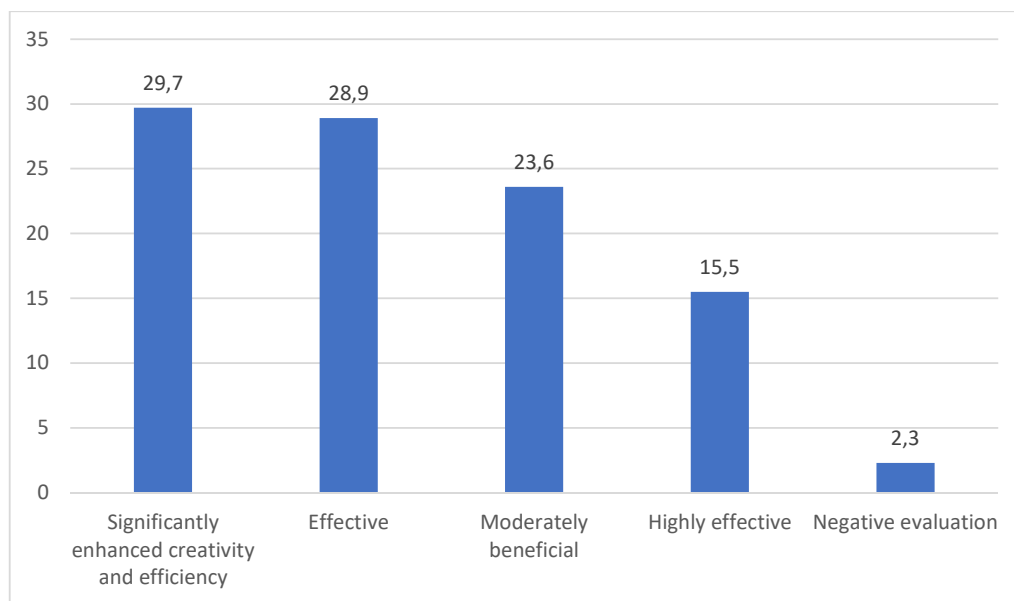
Figure 1

Evaluation of AI usage in the educational process



The findings presented in Figure 1 indicate that AI technologies have become increasingly integrated into the educational process. The majority of participants (58.8%) reported moderate use of AI tools in their academic activities. Furthermore, 25.7% indicated intensive use of AI technologies, demonstrating that a substantial proportion of students actively employ AI to support their learning. A smaller

percentage of respondents reported limited use (10.1%), while only 3.4% stated that AI was fully integrated into their educational activities. The proportion of students who did not use AI at all was relatively low (2.0%). These findings suggest that AI technologies are gradually becoming an important component of students’ educational experiences.

Figure 2*Effectiveness of using ChatGPT in the educational process*

The results presented in Figure 2 demonstrate generally positive perceptions regarding the effectiveness of ChatGPT in the educational process. Approximately 29.7% of participants reported that ChatGPT significantly enhanced both creativity and learning efficiency. Additionally, 28.9% evaluated the tool as effective, while 23.6% considered it moderately

beneficial. A further 15.5% perceived ChatGPT as highly effective in supporting academic learning. Only 2.3% of respondents expressed negative evaluations. Overall, the findings indicate that students view ChatGPT as a valuable educational resource that contributes positively to learning outcomes.

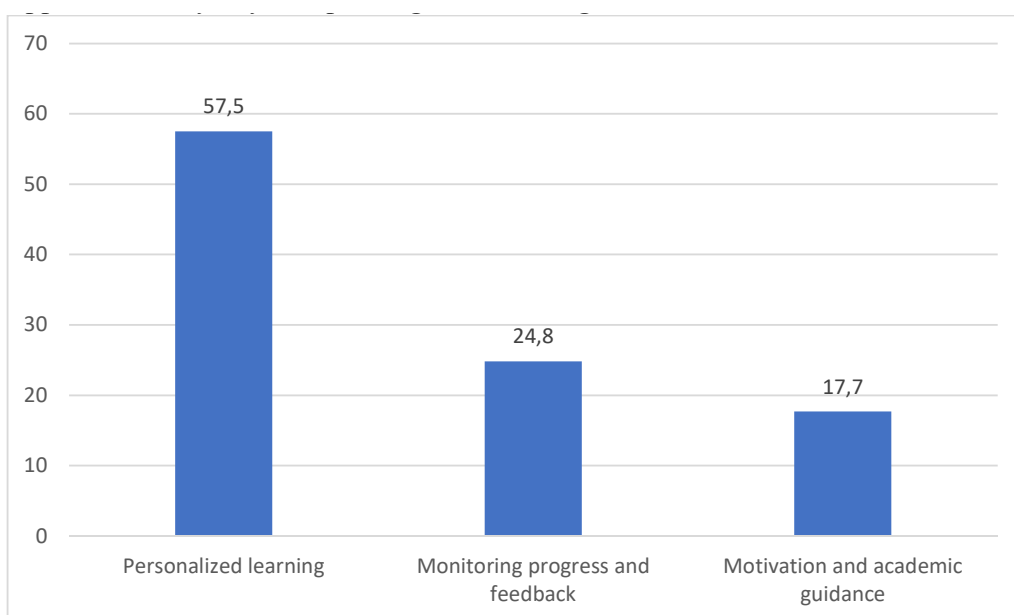
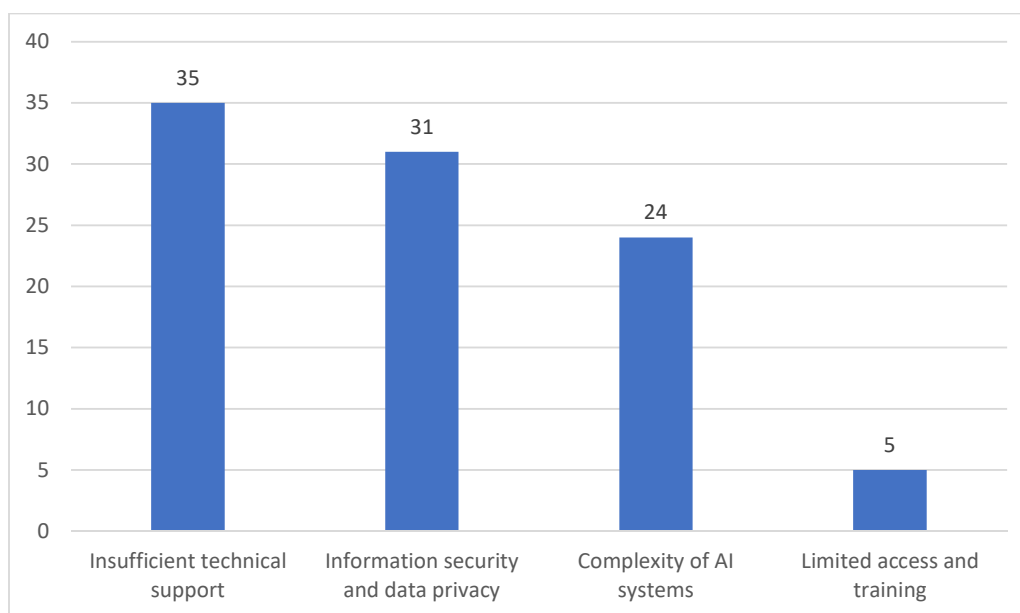
Figure 3*Opportunities of AI for improving students' cognitive skills*

Figure 3 illustrates students' perceptions of AI technologies in supporting cognitive skill development. More than half of the respondents (57.5%) identified personalized learning opportunities as the most significant advantage of AI applications. Approximately 24.8% emphasized AI's ability to monitor learning

progress and provide timely feedback. Another 17.7% highlighted the psychological support that AI systems can provide through motivation and academic guidance. These findings suggest that students perceive AI as an effective tool for enhancing both cognitive development and individualized learning experiences.

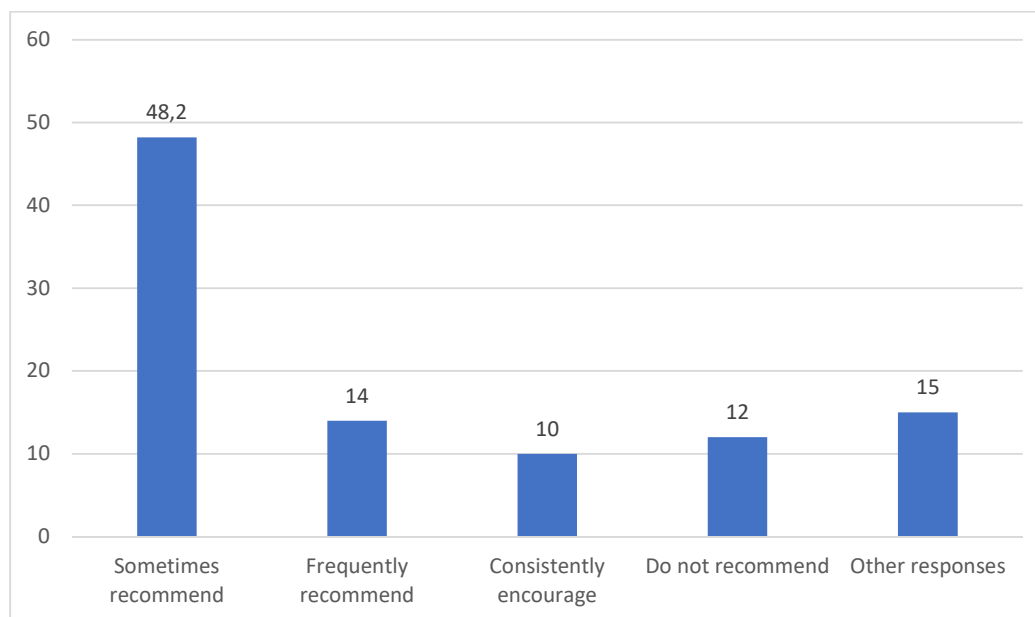
Figure 4

Barriers to using AI in education



The analysis of barriers to AI implementation, presented in Figure 4, revealed several challenges. The most frequently reported obstacle was insufficient technical support (35%), followed by concerns regarding information security and data privacy (31%). In addition, 24% of participants identified the complexity of AI systems as a significant

barrier to effective implementation. Other concerns, including limited access to AI tools and insufficient training opportunities, were reported by 5% of respondents. These results indicate that technological and organizational factors continue to influence the successful integration of AI into educational environments.

Figure 5*Recommendations for using supplementary learning materials with ChatGPT*

The findings shown in Figure 5 demonstrate students' attitudes toward the use of supplementary learning materials alongside ChatGPT. Nearly half of the respondents (48.2%) reported that they sometimes recommend additional learning resources when using ChatGPT. Furthermore, 14.0% frequently recommend supplementary materials, while 10.2% consistently encourage

their use. Conversely, 12.6% of students reported that they do not recommend additional resources, suggesting confidence in ChatGPT as a standalone educational tool. Overall, the results indicate that students recognize the value of combining AI technologies with traditional educational materials to enhance learning outcomes.

Table 1*Likert scale summary table*

Questions	Group 1	Group 2	Group 3	Group 4
How would you evaluate the use of artificial intelligence (AI) technologies in the educational process? (1,1)	15	28	21	20
How would you evaluate the use of AI technologies in the educational process? (2,1)	15	28	23	24
What is your opinion on the impact of ChatGPT or other AI tools on improving the learning process? (3,1)	16	17	19	19
What is your opinion on the effectiveness of using AI tools like ChatGPT? (3,1)	7	8	13	15
What is your opinion on the effectiveness of using AI tools like ChatGPT? (3,1)	7	8	13	15
How effective do you think using AI tools like ChatGPT is in increasing academic motivation? (3,2)	14	15	19	19
How effective do you think using AI tools like ChatGPT is in increasing academic motivation? (3,2)	14	15	19	19
How effective is AI in adapting the educational process to meet the individual needs of students? (3,3)	18	15	16	16

How effective is AI in adapting the educational process to meet the individual needs of students? (3,3)	14	17	14	19
How much does using ChatGPT tools help students improve their independent learning skills? (3,4)	11	12	12	14
How much does using ChatGPT tools help students improve their independent learning skills? (3,4)	11	12	12	14
What recommendations would you make for integrating AI tools into the education system? (3,5)	7	10	10	11
What recommendations would you make for integrating AI tools into the education system? (3,5)	7	10	10	11
Would you provide additional learning materials to students when using ChatGPT? (3,7)	3	5	5	5
Would you provide additional learning materials to students when using ChatGPT? (3,7)	2	3	7	4

The Likert-scale analysis presented in Table 1 revealed generally positive attitudes toward AI technologies across all respondent groups. Groups 2 and 4 demonstrated the highest levels of agreement regarding the educational value of AI and ChatGPT. Participants in these groups consistently selected higher-scale responses,

indicating stronger support for AI integration. In contrast, Group 1 displayed more cautious attitudes, often selecting lower-scale responses. Group 3 exhibited greater variability in responses, suggesting diverse perspectives regarding the role of AI in education.

Table 2

T-test Results Summary for Comparing Groups

Question	Group 1 vs Group 2	Group 1 vs Group 3	Group 1 vs Group 4	Group 2 vs Group 3	Group 2 vs Group 4	Group 3 vs Group 4
Q1	1.13062, 0.1930	2.05515, 0.04109	0.24412, 0.04112	1.4674, 0.8277	0.83084, 0.8376	1.9278, 0.109824
Q2	0.00825, 0.9934	0.01492, 0.9934	0.00896, 0.9932	0.00681, 0.9937	0.00272, 0.9937	0.02327, 0.9937
Q3	0.14772, 0.6991	0.28023, 0.4994	0.18541, 0.5453	0.13553, 0.6997	0.11267, 0.6967	0.40042, 0.1927
Q4	nan, nan	nan, nan	nan, nan	nan, nan	nan, nan	nan, nan
Q5	0.11602, 0.9301	0.39401, 0.3321	0.28062, 0.4892	0.20862, 0.5914	0.29752, 0.4928	0.28607, 0.4972
Q6	0.46620, 0.6491	0.48151, 0.6387	0.12718, 0.8997	0.12497, 0.8997	0.12982, 0.8997	0.12982, 0.8997
Q7	0.34920, 0.7327	0.49531, 0.6397	0.29198, 0.7279	0.43563, 0.6094	0.30966, 0.7267	0.44242, 0.6357
Q8	0.08921, 0.9825	0.02931, 0.9987	0.02984, 0.9986	0.06894, 0.9875	0.13894, 0.9762	0.12674, 0.9842
Q9	0.89510, 0.3765	0.40016, 0.8528	0.47984, 0.8202	0.39384, 0.8475	0.38984, 0.8427	0.44242, 0.6357
Q10	0.42404, 0.9017	1.27277, 0.0000	1.11451, 0.0000	0.98984, 0.12992	1.2277, 0.0000	1.2277, 0.0000

The t-test results presented in Table 2 indicate that statistically significant differences between

groups were limited. Most group comparisons produced p-values greater than 0.05, suggesting

that perceptions of AI technologies were largely consistent across the sample. Significant differences were observed only for selected items, particularly those related to perceptions

of AI implementation in education. These findings suggest that although minor variations exist among respondent groups, overall attitudes toward AI remain relatively homogeneous.

Table 3

ANOVA results summary for comparing groups

Comparison	F-statistic	P-value
Comparison for Q1	1.62762	0.18790
Comparison for Q2	NaN	NaN
Comparison for Q3	1.25524	0.29602
Comparison for Q4	NaN	NaN
Comparison for Q5	NaN	NaN
Comparison for Q6	0.51656	0.67166
Comparison for Q7	0.19931	0.89668
Comparison for Q8	0.92291	0.43243
Comparison for Q9	0.36147	0.78102
Comparison for Q10	0.83236	0.48631

Similarly, the ANOVA results presented in Table 3 confirmed the absence of substantial differences among groups. For most survey items, p-values exceeded the conventional significance threshold of 0.05, indicating that respondents shared comparable perceptions regarding the effectiveness, usefulness, and educational value of AI technologies. The findings therefore demonstrate a broad consensus concerning the positive role of AI in contemporary educational practice. Overall, the results indicate that students hold favorable attitudes toward artificial intelligence and recognize its potential to improve learning quality, support personalized instruction, increase academic motivation, and facilitate cognitive skill development. At the same time, participants emphasized the importance of addressing technical, organizational, and ethical challenges to ensure successful implementation of AI technologies within educational settings.

Discussion. The purpose of this study was to investigate students' perceptions of artificial intelligence technologies and their application within educational environments. The findings demonstrate that students generally hold positive attitudes toward AI integration and recognize its potential to enhance learning experiences, improve academic performance,

and support personalized education. One of the most significant findings of the study is the widespread use of AI technologies among future teachers. The majority of participants reported moderate or intensive use of AI tools, indicating that these technologies are becoming increasingly embedded within higher education. This trend reflects the growing digitalization of educational processes and the expanding role of AI-supported learning environments.

The results further revealed that students perceive ChatGPT as an effective educational resource. Participants emphasized its contribution to creativity, learning efficiency, and academic motivation. These findings are consistent with previous studies suggesting that AI-powered tools facilitate personalized learning experiences and provide learners with immediate access to educational support. The positive evaluations observed in the present study indicate that students increasingly view AI as a valuable complement to traditional teaching methods rather than a replacement for educators. The findings regarding cognitive skill development are particularly noteworthy. Most respondents identified personalized learning as the primary advantage of AI technologies. This supports contemporary educational theories emphasizing learner-centered instruction and

adaptive learning environments. AI systems enable students to receive individualized feedback, monitor their progress, and access educational content tailored to their specific needs, thereby enhancing self-regulated learning and academic achievement.

At the same time, the study identified several barriers that may limit the effective implementation of AI technologies. Technical support deficiencies, information security concerns, and system complexity emerged as the most frequently reported challenges. These findings highlight the importance of developing institutional infrastructure, providing professional training, and establishing clear ethical guidelines for AI use in education. Without addressing these issues, the full educational potential of AI technologies may not be realized. The present findings support the conclusions of Akgun and Greenhow (2021), who emphasized the need to carefully consider the ethical implications of AI use in educational settings. Concerns regarding excessive reliance on AI technologies and their potential influence on critical thinking remain important considerations for educational policymakers and practitioners. At the same time, the findings are also consistent with Haleem et al. (2022), who reported that AI technologies contribute positively to personalized learning, student engagement, and educational outcomes.

The statistical analyses further strengthen the interpretation of the results. Both t-test and ANOVA findings demonstrated that students from different groups generally share similar perceptions regarding AI technologies. The absence of substantial differences across groups suggests that positive attitudes toward AI are widespread and not limited to specific subpopulations of students. This consistency indicates a growing acceptance of AI as a legitimate and beneficial educational tool.

Overall, the findings suggest that artificial intelligence has considerable potential to enhance educational quality, support inclusive learning environments, and promote students' cognitive and academic development. Future research should focus on examining long-term educational outcomes associated with AI implementation, exploring teachers' readiness to integrate AI technologies, and developing evidence-based strategies for addressing technical and ethical challenges. Such efforts will contribute to the effective and responsible integration of artificial intelligence into modern educational systems.

Conclusion. The introduction of artificial intelligence technologies such as ChatGPT into education opens new opportunities for improving learning quality, student engagement, and cognitive development. AI supports personalized learning by adapting educational content to individual student needs, which can enhance efficiency, analytical thinking, and critical skills. However, despite its advantages, the integration of AI into education raises important strategic and ethical questions, including academic integrity, data privacy, and algorithmic bias. In addition, limitations such as insufficient technical infrastructure and unequal access to digital resources remain significant barriers to full implementation. This study analyzes students' use of ChatGPT and other AI tools in academic settings and evaluates their impact on creativity and cognitive skills. The findings suggest both positive outcomes and existing challenges in AI-supported learning environments. Effective integration of AI requires not only technological development but also strong ethical guidelines and pedagogical frameworks. AI should complement, not replace, traditional teaching methods, preserving the human aspect of education and supporting the development of independent learners.

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