Contents lists available at Science-Gate

International Journal of Advanced and Applied Sciences

Journal homepage: https://www.science-gate.com/IJAAS.html

The impact of artificial intelligence on cognitive skill development in future professionals

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ARTICLE INFO

Article history:
Received 6 February 2026
Received in revised form
12 July 2026
Accepted 18 July 2026

Keywords:
Generative AI
Cognitive skill development
AI-assisted learning
Blended learning
Multilingual education

ABSTRACT

This study aims to examine how the use of Generative AI affects the development of cognitive skills among future professionals in the multilingual and multicultural education system of Kazakhstan. To achieve this, a combination of quantitative survey data and qualitative insights from semi-structured interviews was used. The research sample consisted of 148 fourth-year students from Kazakh- and Russian-language communities. Quantitative data were analyzed using descriptive statistics and the non-parametric Kruskal–Wallis H test to evaluate differences in perceptions. The findings show that participants mainly viewed AI as a supportive cognitive resource that helped them engage in the learning process and personalize their learning experience. The highest scores were observed in the Cognitive and Motivational Drivers dimension, while the Self-Directed Learning dimension suggests that students approached AI-assisted learning with some caution. The results indicate the presence of a blended learning model in which students integrate modern technologies into their education while continuing to rely on traditional learning approaches. No statistically significant differences were found between the two language groups, indicating similar attitudes toward AI. However, the findings cannot be generalized because of the specific context and the limited scope of the study.

1. Introduction

Nowadays, Artificial Intelligence (AI) technologies reshape modern education, creating more adaptive and personalized environments for teaching and learning. In recent times, new tools, such as Generative AI and Chat Generative Pre-Trained Transformer (ChatGPT), have emerged, which have allowed introducing a new form of interaction with the content not limited by conventional instructional means. In turn, this makes it possible to consider AI as an effective means of increasing cognitive engagement and developing higher-order cognitive skills. Recent studies suggest that the use of AI in learning helps to develop cross-curricular skills of critical thinking, creativity, and communication (Bollaert, 2025; Deroncele-Acosta et al., 2025). Nevertheless, along with the positive aspects of AI incorporation into the educational process, there are certain concerns related to plagiarism, algorithmic bias, personal data security, and over-reliance on technology, discussed extensively in recent academic literature (Phua et al., 2025; Roe and Perkins, 2022). All this indicates that the introduction of AI tools should be done with caution and in consideration of its advantages and disadvantages (Sullivan et al., 2023).

While there exists a considerable body of research regarding the impact of AI technologies on cognitive processes in learning, there is very little empirical research examining the effect of AI on cognitive development in a multilingual and multicultural environment. The role of AI tools in

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student cognitive experience and development is particularly understudied in the case of bilingualism.

Therefore, this paper aims to analyze how the use of Generative AI affects the cognitive development of university students studying in a bilingual educational environment. The study will examine patterns of Generative AI use, the extent to which this technology contributes to the development of students' cognitive abilities, and the challenges of integrating AI into academic practice in a bilingual setting. To achieve this aim, a mixed-methods approach will be used, combining quantitative data collected through a 5-point Likert-scale questionnaire with qualitative data obtained from semi-structured interviews. The study sample will consist of 148 fourth-year students divided into four groups based on their language of instruction (Kazakh or Russian). The quantitative data will be analyzed using descriptive statistics and non-parametric inferential tests. Specifically, the Kruskal–Wallis H test will be used to identify significant differences among the four groups.

2. Literature review and conceptual background

2.1. AI in education: Cognitive opportunities and risks

The integration of AI in the educational process resulted in a number of theoretical debates related to possible impacts that AI may have on the cognitive processes. According to Dave (2025), one of the major risks of excessive usage of AI in educational practice is the weakening of abilities of critical thinking and making decisions. It suggests that excessive dependence on automated software solutions may limit chances for deep cognitive activities. Alternatively, there is a perspective according to which AI may be beneficial if used appropriately because it allows enhancing cognitive processes such as analyzing and reflecting. According to Haleem et al. (2022) and Shiri et al. (2025), ChatGPT may become a tool supporting cognitive activity rather than replacing it. As a result, the issue of using AI in education becomes a controversial topic characterized by various points of view. However, AI, in addition to impacting the results of educational activities, affects the experience of participants. As Japoshvili-Ghvinashvili and Suleman (2023) and Shiri and Baigutov (2025) stated, the introduction of AI tools influences knowledge acquisition during the learning process. Apart from that, ethical concerns such as algorithmic bias, academic misconduct, and others are essential in discussions related to the use of AI technology (Albadarin et al., 2024; Zhou et al., 2024).

2.2. AI-driven learning and educational transformation

The adoption of AI in the process of education marks a significant change in methodology, since teachers can now focus on more cognitive activities with their students. ChatGPT is one such method, which gives an alternative to traditional teaching methods, fostering adaptability and learner-centered approach to learning.

Since generative models respond and adapt instantly to the progress made by learners, they become quite aligned with modern concepts of "Education 4.0 and 5.0," where personalization and competence are at the core of learning (Samadhiya et al., 2025). In this context, AI is perceived not as a replacement for educators but as a cognitive tool that facilitates self-regulated learning.

2.3. Personalization and cognitive development

A primary benefit of AI, particularly intelligent tutoring systems and Large Language Models (LLMs), is their ability to customize content to match specific learner needs. This customization does not merely boost academic performance; it actively stimulates critical thinking and problem-solving skills (Haleem et al., 2022). Recent studies suggest that ChatGPT encourages users to understand complex information better and thus gives in-depth insight into complicated issues (Deep and Chen, 2025; Nasr et al., 2025). According to Nasr et al. (2025), the efficiency of such methods is highly dependent on the process of interaction. AI performs quite well whenever students generate and connect ideas in the phases of exploration and integration. However, its results are not very successful in the "resolution phase," which involves serious cognitive activities.

2.4. Feedback and student engagement

Interactive elements of AI prove to be highly effective in ensuring students' engagement in the educational process. Instant feedback that LLM models such as ChatGPT-4 offer enables students to perceive information considerably quicker than in conventional forms of communication (Kasneci et al., 2023). Moreover, studies show that using high-quality prompts, students receive feedback comparable to human expert opinion in terms of specificity and coherence (Jacobsen and Weber, 2025; Shiri and Baigutov, 2024). This phenomenon is evident in narrow fields of study such as computer science and database management, where the effectiveness of academic performance depends on the purposeful use of AI technology (Aydın and Karaarslan, 2023).

2.5. Ethical challenges and the role of the instructor

Despite all the benefits discussed above, the incorporation of any innovation into the core of educational practices cannot be accomplished without taking certain ethical and structural factors into account. For instance, it should be stated from

the outset that the problem of privacy remains topical and requires special consideration. According to the research conducted by Shahriar and Dara (2025), even sophisticated AI systems, including GPT-4, are vulnerable to information leaks. In addition to that, the list of issues that should be discussed when using any type of technological solution does not end there. To begin with, any model may feature such "built-in" problems as a lack of genuine creativity (as compared to the one that people possess), as well as algorithmic bias and disinformation. As a result, while it is true that instructors no longer need to check whether their students know everything about the assigned topic, they still retain their right to play the roles of an ethical guide and a fact-checker.

As was mentioned before, over-reliance on technology is not advised at all since AI systems, even the most sophisticated ones, serve as a complement, but not as a replacement for human instruction (Fitria, 2021). Otherwise, it is likely that a gradual deterioration of students' independent work will occur. According to Zhai (2023), the overuse of AI-based solutions in learning processes causes what has been called academic rigidity. At the same time, a critical approach and adherence to ethics should be considered when incorporating AI solutions in education. Therefore, the final aim of AI application in this sphere is to create "technological equilibrium," which will enable teachers and learners to effectively implement innovative approaches (Zhong and Rosli, 2025).

3. Materials and methods

3.1. Research design and approach

To get a truly well-rounded look at how Artificial Intelligence, and ChatGPT in particular, is reshaping education, this study uses a mixed-methods research design. By blending qualitative and quantitative approaches, we want to bridge the gap between the personal, subjective experiences of users and the more objective side of academic results (Japoshvili-Ghvinashvili and Suleman, 2023). On the qualitative side—which includes literature reviews, thematic analysis, and semi-structured interviews—we're able to gain a much more nuanced understanding of how both teachers and students actually feel about bringing AI into the classroom. On the flip side, the quantitative phase brings in structured surveys and inferential statistics (non-parametric tests, specifically the Kruskal–Wallis H test) to examine differences in students' perceptions of AI across groups.

3.2. Participants and sampling logic

In the current study, a convenience sample of 148 fourth-year students majoring in the specialty "Teaching and Primary Education Methodology" at the Kazakh National Women's Pedagogical University in Almaty is considered. This particular group of students is usually 22-23 years old, and it has been selected to represent the late stages of education, thus guaranteeing the sufficient academic level needed for analyzing AI's potential for future professional activities.

For a more organized assessment of the impact of different languages on the use of AI in education within the multi-ethnic environment in Kazakhstan, the participants were further divided based on their major language of instruction, namely Kazakh (Groups 1 and 2) and Russian (Groups 3 and 4). The current research focuses mainly on a female sample, which facilitates minimizing possible gender differences regarding the perception of modern technologies.

It should be noted that the sample consists of a relatively small number of individuals studying at the same university; therefore, the findings of this research cannot be extrapolated to a wider audience. Moreover, a non-random sampling procedure was implemented during the study; hence, the potential for bias cannot be ruled out.

3.3. Data collection and analytical tools

Data were collected using a multi-stage methodology that sought to capture the Perception of AI Role in Education. Data collection was conducted via a structured 5-point Likert Scale questionnaire with the aim of gauging students' attitudes along three conceptually different dimensions of Core Educational Utility, Cognitive and Motivational Drivers, and Self-Directed Learning and Strategies. The options ranged from Strongly Disagree with a value of 1 to Strongly Agree with a value of 5. To maintain consistency in analyzing results, the ten questions were classified into three construct themes on account of conceptual proximity. In order to conduct quantitative analysis in an appropriate manner given the ordinal nature of the data, descriptive and inferential statistical analyses were adopted. In particular, mean and standard deviation were utilized alongside non-parametric analysis, with the Kruskal-Wallis H test used to compare the four student groups.

3.4. Results

Analyzing the way Generative AI is incorporated into the teaching process provides evidence that its involvement is not a simple yes/no choice but an integral part of a multi-level educational procedure. Based on three main analytical criteria—Core Educational Utility, Cognitive and Motivational Drivers, and Self-Directed Learning and Strategy—the survey results have identified coherent yet diversified patterns of learners' engagement.

Student Engagement and Perception Patterns Distribution: In regard to initial student perception patterns presented in Fig. 1, one can state that the surveyed students follow a pragmatic and systematic

attitude towards the usage of AI-based learning resources.

The Paradox of Moderately Active Usage (Core Educational Utility): According to the findings, the majority of learners (58.8%) use AI tools in the context of moderate activity. It implies that AI is recognized as an effective learning support tool rather than a substitute for conventional educational methods.

High Efficacy vs. Cautious Dependency (Cognitive and Motivational Drivers): Nearly 58.6% of respondents reported high or extremely high perceived effectiveness of ChatGPT. This indicates that students view AI as a cognitive support tool that enhances creativity and efficiency, aligning with the concept of a cognitive accelerator.

The Necessity of a Hybrid Pedagogical Model (Self-Directed Learning and Strategy): The findings indicate that 48.2% of students still consider traditional learning materials moderately necessary. This suggests the emergence of a hybrid learning strategy, where AI is integrated into learning processes but does not replace conventional academic frameworks (Fig. 1).

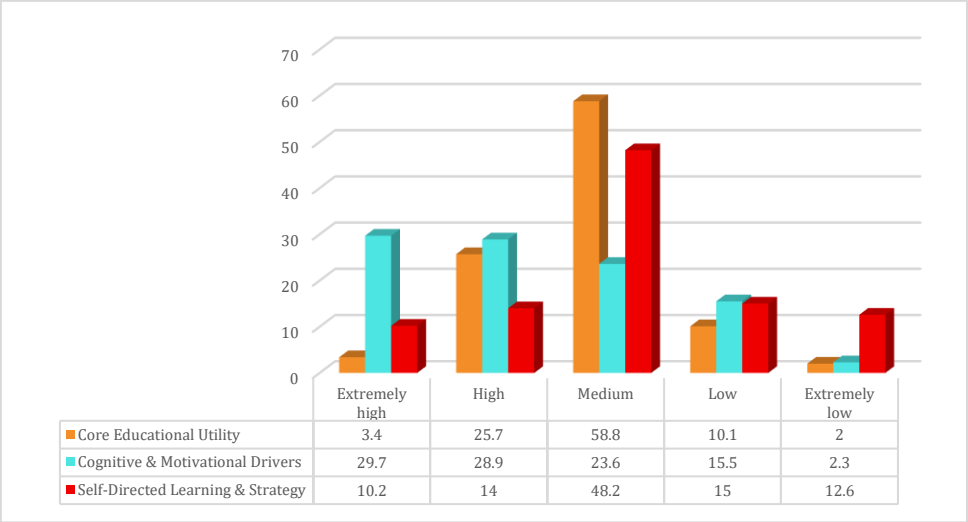

Fig. 1: Distribution of student responses across key AI integration dimensions

Fig. 2 shows the mean score for the three analytical perspectives. It is evident from the findings that Cognitive and Motivational Drivers have the highest mean score (M = 3.68), which shows that students view AI as enabling interaction and learning that is personalized. The second highest mean score was found under Core Educational Utility, where the mean score was 3.18, showing consistency in the application in learning processes. The last perspective to score lowest was Self-Directed Learning and Strategy, whose mean score was 2.94.

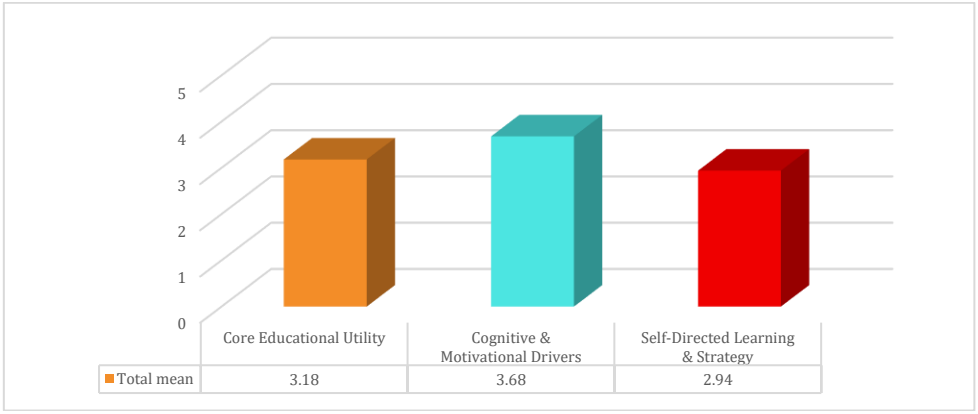

Fig. 2: Aggregate mean scores for primary AI impact factors

3.4.1. Specific opportunities for cognitive enhancement

The effect of artificial intelligence (AI) technologies on the cognitive development and educational process of students is further discussed through the use of Fig. 3. The analysis of students' perception moves from the mere ability of these systems to provide information towards their role in reshaping the methods of studying. As can be seen in the graph below, the most common response to the question about the effect of AI technologies (57.5%) was related to personalized learning facilitated by the use of AI technologies. It is quite obvious that this result reflects a significant benefit for educational purposes since it demonstrates that students find AI tools helpful in tailoring learning experiences according to personal needs and

interests. Another 24.8% view AI technologies as an academic GPS helping them assess their progress and receive instant feedback necessary for developing their cognitive skills. Surprisingly, another 17.7% consider AI technologies helpful in dealing with their psychological state because they find access to these systems less stressful and motivating for focusing on studies.

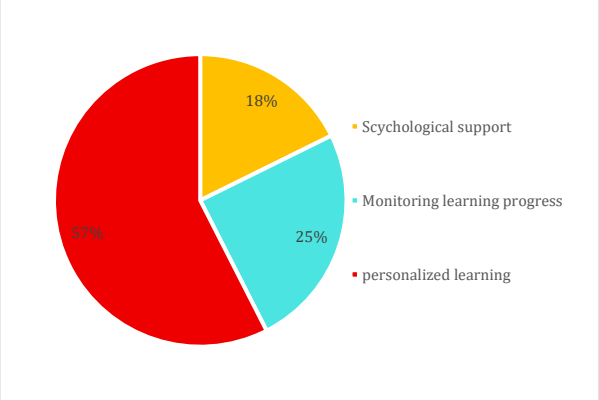

Fig. 3: Opportunities of AI for improving students' cognitive skills

3.4.2. Dimensional analysis of student perceptions

An analysis of student responses was conducted from the perspective of three key aspects reflecting their perceptions of the influence of artificial intelligence on education.

1. Essential Educational Value (Questions Q1–Q4): The results indicate a relatively consistent evaluation across all four groups, with average scores ranging from 2.85 to 3.52. The highest perceived educational value (M = 3.52) was reported by Group 1, whereas the lowest (M = 2.85) was observed in Group 4. However, the Kruskal–Wallis test showed no significant differences among the groups (H < 4.35, p > 0.29).
2. Cognition and Motivation Drivers (Questions Q5–Q7): This construct received the highest average scores both overall (Q5–Q7: M = 3.47) and within individual groups (M = 3.83 for Group 1 and M = 3.73 for Group 2). Despite these relatively high scores, the Kruskal–Wallis test did not identify any significant differences among the groups (H < 3.12, p > 0.09).
3. Self-Direction and Strategy (Questions Q8–Q10): Compared with the previous aspect, this dimension showed lower average scores (Q8–Q10: M = 2.94), ranging from 2.70 to 3.16. The highest average score was observed in Group 4 (M = 3.16). Nevertheless, the Kruskal–Wallis test indicated that the differences among the groups were not statistically significant (H < 1.96, p > 0.124) (Table 1).

Table 1: Cross-linguistic comparative analysis of student perceptions: Group means and Kruskal–Wallis H test results

Item	Kazakh (mean)		Russian (mean)		H statistic (Kruskal–Wallis)	p-value
	Group 1	Group 2	Group 3	Group 4		
Core educational utility (Q1–Q4)	3.52	3.20	3.05	2.85	H = 4.35	0.29
Cognitive and motivational drivers (Q5–Q7)	3.83	3.73	3.53	3.60	H = 3.12	0.09
Self-directed learning and strategy (Q8–Q10)	2.83	2.70	3.03	3.16	H = 1.96	0.124

Perhaps the most notable aspect of the data lies in its homogeneity. All of the p-values calculated turn out to be greater than 0.05, ranging from 0.09 to 0.29. In other words, these numbers demonstrate that students' perceptions of AI are the same for all groups with no statistical differences between them. Thus, we may conclude that there are similar perceptions concerning Kazakh- and Russian-speaking groups within this sample. As regards the different categories, the highest level of agreement was recorded in the Cognitive and Motivational category, which scored the best. For example, regarding the category Personalization, Kazakh-speaking groups scored an average of 4.1, and Russian-speaking students scored an average of 3.8. This result is congruent with our earlier conclusion about Perceived Effectiveness scoring highly at an average score of 3.68. Therefore, AI appears to be perceived as not only the tool that helps with ordinary tasks but as the personal instrument that promotes cognitive development as well. Even though the more conservative categories also showed the same level of agreement, one can see that there are no differences: students have moderate scores on the Self-Directed Learning domain, as well. Specifically, these scores are approximately 2.9, as opposed to the previously mentioned 2.94. Apparently, regardless of the language of instruction, all students have a moderate perception of AI: they perceive it as potentially useful while admitting that conventional lessons led by teachers remain essential. This balanced position stems from students' understanding that though AI is perceived as intellectually beneficial, it should be combined with conventional learning materials.

Finally, the scores in Core Educational Utility (Q1-Q4) range from 3.5 to 3.8, which is congruent with Utilization Rate's average score of 3.18.

3.4.3. Challenges and barriers to AI integration: A mixed-methods analysis

Despite the justified interest in using AI as a "cognitive catalyst," our research suggests that the implementation of fully digitalized education still faces some resistance. To obtain a comprehensive picture, both the survey results and interviews with students and teachers were used to gather opinions. The analysis of these views highlights several challenges that affect not only the implementation of innovation but also the development of future professionals' skills (Fig. 4).

1. Technical Infrastructure as a Barrier to Cognitive Fluency: The biggest challenge, reported by 35% of participants, was the "Lack of technical support." Further analysis of the interviews showed that this issue is not limited to having enough computers or a stable internet connection. The main concern is the absence of timely support when AI tools do not function properly. For future teachers, this technical friction creates what can be described as a "cognitive break." Instead of remaining engaged in a high-level creative task, students are forced to stop and spend mental effort solving technical problems. As one student explained during the interview: "It's just a total mood-killer. You're finally in the zone with an assignment, and the AI just lags or glitches out. Since there's nobody to help fix it, I just give up and close my laptop. It completely ruins my focus."
2. Data Ethics and Information Security: Security concerns were the second most frequently reported challenge, identified by 32% of participants. From the perspective of cognitive development, this reflects a psychological barrier related to the "privacy-utility trade-off." Future professionals are becoming increasingly aware of the ethical management of their intellectual property when using third-party generative AI models. A student from the Kazakh-speaking group expressed this concern as follows: "I'm lowkey scared to put my real ideas in there. I keep thinking, 'Wait, is this even mine anymore?' If the university doesn't have a clear safety policy, I'm going to keep holding back my best work. It really stops me from using the tool to actually grow."
3. Algorithmic Complexity vs. Cognitive Load: Furthermore, 24% of students identified the "Complexity of AI systems" as a major challenge. Although AI is intended to improve the efficiency of cognitive processes, the qualitative feedback indicates that the steep learning curve associated with prompt engineering may create "extraneous cognitive load," where the effort required to use the tool outweighs its benefits. One respondent stated: "Honestly, 'learning to prompt' feels like an extra class I didn't even sign up for. Sometimes I spend so much time trying to make the AI understand me that I'm like, 'I could've just done this faster myself.' It ends up being a massive headache."
4. Preserving the "Human Core" of Cognitive Growth: Finally, a smaller but noteworthy group (9%) reported "Other issues," which were clarified during the semi-structured interviews as concerns about technology dependence and the possible decline of traditional cognitive skills. A common concern among senior students was that excessive reliance on AI could weaken their own professional judgment: "I'm worried I'll just stop thinking for myself if I use AI for everything. It's cool for facts, but it doesn't get the 'vibe' of a classroom or how people actually work. I don't want to graduate as some specialist who just knows how to click buttons. I need that human instinct."

Overall, these findings suggest that successfully integrating AI into education requires more than simply providing access to AI tools. It also requires a comprehensive support system that reduces students' cognitive load and addresses their ethical concerns. With appropriate infrastructure and guidance, AI can become not a technical obstacle but a valuable tool that supports more structured, reflective learning and the development of genuine professional expertise.

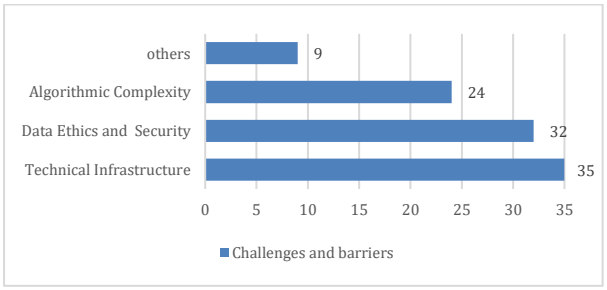

Fig. 4: Perceived challenges and barriers to AI integration

4. Discussion

In general, the current investigation proves that Generative AI works primarily as a cognitive scaffold instead of substituting the traditional forms of studying. Hence, it seems that AI represents the external cognitive scaffold allowing students to deal with academic activities while sticking to structured instruction.

4.1. AI as a catalyst for cognitive and motivational growth

The moderately high mean score for Cognitive and Motivational Drivers (M = 3.68) proves that students see AI as a tool used to improve their motivation and increase engagement. The obtained result is supported by previous studies showing that AI is capable of creating personalized learning experiences. However, it should be mentioned that the sample under consideration includes the representatives of one particular institution only, and thus, the results cannot be generalized.

4.2. The hybrid strategy and cognitive balance

The average score for Self-Directed Learning and Strategy (M = 2.94), along with the fact that 48.2% of the participants still use traditional learning sources, demonstrates that the students have started using a hybrid strategy to cope with the learning process. In other words, they have adopted a balanced approach to dealing with academic tasks and using technological means for achieving positive outcomes. Thus, it becomes clear that the use of Generative AI tools does not necessarily imply a radical shift in learning behaviors.

4.3. Addressing the barriers to specialist expertise

As for the major barriers to using AI, such as the lack of sufficient technical assistance (35%), the concerns about privacy and data security (32%), and complexity (24%), they clearly show the structural problems that arise in this case. Nevertheless, it should be noted that the participants understand that AI can be helpful in some areas only and use the technology selectively when performing specific activities, e.g., obtaining personalized feedback or tracking learning outcomes (57%; 25%).

4.4. Consistency across linguistic groups

The Kruskal–Wallis test results indicate no statistically significant differences between linguistic groups ($p > 0.05$), suggesting that perceptions of AI are relatively consistent within this specific academic context. However, this consistency should be interpreted as context-dependent rather than universally applicable.

4.5. Study limitations

It is worth mentioning that while the conducted research provides valuable information about the importance of Generative AI for the development of cognitive skills, a number of limitations associated with it need to be highlighted. Firstly, the current study focuses on only one university – Kazakh National Women's Pedagogical University. It means that generalization of the results obtained from it is impossible, because the findings can be used only within the studied environment.

Secondly, all findings were gathered through the analysis of self-reported data, collected in the course of administering Likert-scaled questionnaires. While every effort was taken to provide clear wording of all questions, it does not negate the probability of response bias occurring when interpreting the findings. Specifically, the perceptual data can be influenced by personal attitude and subjective interpretation of each survey item.

Thirdly, while the quantitative analysis utilized a non-parametric statistical method (Kruskal–Wallis H test), it still cannot be considered longitudinal as it is characterized by a cross-sectional approach. It means that the results reflect only current perceptions, without providing a basis for the analysis of changes that can take place over time.

Finally, the qualitative data provided through interview analysis cannot be taken as representative due to the limited number of respondents interviewed.

5. Conclusion

The current research explores the influence of Generative AI technology on the student learning experience within a specified environment, suggesting that AI is predominantly used as an auxiliary educational resource, but not as an alternative to existing learning methods. It can be concluded that students' interaction with Generative AI is selective and purposeful since it is incorporated into the scholarly routine and students still depend on traditional learning processes.

Based on the obtained findings, it is possible to suggest that the strongest influence of Generative AI on learning occurs in the field of cognitive and motivational factors ($M = 3.68$). In turn, the average degree of influence on education and self-directed learning and strategies is demonstrated ($M = 3.18$; $M = 2.94$), which indicates that students tend to approach the use of Generative AI in a cautious way.

In this context, it can be assumed that the use of Generative AI contributes to the development of a hybrid learning strategy in which AI technologies serve as complementary resources rather than substitutes for other methods of gaining knowledge. It appears that students use Generative AI selectively when it comes to generating ideas and clarifying information.

Moreover, the lack of statistically significant differences among the linguistic groups in terms of generative AI influences on learning perception ($p > 0.05$) implies the universality of opinions on the subject matter in the studied population. However, these conclusions cannot be generalized to other groups since the study is limited to one educational institution and one ethnic group.

List of abbreviations

AI	Artificial intelligence
ChatGPT	Chat generative pre-trained transformer
GPS	Global positioning system
GPT-4	Generative pre-trained transformer 4
LLMs	Large language models
Q1–Q10	Questionnaire items 1–10

Funding

This research was conducted within the framework of the "Zhas Galym" grant project for 2024–2026, funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan [grant number AP22684921].

Compliance with ethical standards

Ethical considerations

This study was conducted in accordance with established ethical standards for research involving human participants. Prior to participation, written informed consent was obtained from all participants at the beginning of the questionnaire form. Participants were informed about the purpose of the study, the voluntary nature of their participation, and their right to withdraw from the study at any stage without any negative consequences. To ensure confidentiality and privacy, all responses were

collected anonymously, and no personally identifiable information was recorded. The collected data were used solely for academic and research purposes and were stored securely. Furthermore, the study protocol and research procedures were reviewed and approved by the Ethics Committee of the Kazakh National Women's Pedagogical University (Approval No. 2024/47).

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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