

Торайғыров университетінің
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НАУЧНЫЙ ЖУРНАЛ
Торайғыров университета

Торайғыров университетінің ХАБАРШЫСЫ

Педагогикалық сериясы
1997 жылдан бастап шығады



ВЕСТНИК ТОРАЙГЫРОВ УНИВЕРСИТЕТА

Педагогическая серия
Издается с 1997 года

ISSN 2710-2661

№ 2 (2026)

Павлодар

НАУЧНЫЙ ЖУРНАЛ
Торайгыров университета

Педагогическая серия
выходит 4 раза в год

СВИДЕТЕЛЬСТВО

о постановке на переучет периодического печатного издания,
информационного агентства и сетевого издания

№ KZ03VPY00029269

выдано

Министерством информации и коммуникаций
Республики Казахстан

Тематическая направленность

публикация материалов в области педагогики,
психологии и методики преподавания

Подписной индекс – 76137

<https://doi.org/10.48081/BGQF2048>

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METACOGNITIVE AWARENESS OF PRE-SERVICE LANGUAGE TEACHERS THROUGH AI-POWERED LANGUAGE LEARNING ENVIRONMENTS

The current article is devoted to examining the metacognitive awareness (MA) of pre-service language teachers in AI-supported language learning contexts. It explores the role of AI in facilitating self-regulated learning and critical thinking and innovative reflective teaching practice of the future teacher candidates. The use of artificial intelligence (AI) tools for language learning in a broader sense has emerged as a key research area in recent years. The significance of the research is conditioned by the active introduction of the AI technologies into the modern educational process and their potential in development on metacognitive skills. The aim of this study is to investigate pre-service language teachers' planning, monitoring, evaluation and regulation of their learning processes, determining the role of AI in pre-service language teachers' developing metacognitive skills. The mixed methods approach used to collect quantitative data from a survey, and a review of scientific literature about the role of metacognition and AI on language learning were done. The research was conducted among 100 pre-service language teachers' of al-Farabi Kazakh National University. The survey was administered through Google Forms. The results demonstrate that students use the AI tools quite often, and these tools have a positive influence on their skills to self-regulate. Such practices highlight that metacognitive strategies should embrace flexibility and adaptability, and that artificial intelligence may play a crucial role in effective teaching. Understanding these aspects is crucial for teacher education programs to enable future teachers not only to be adept at the use of technology but also to give students the skills to use self-regulatory and

thinking strategies. Overall, the results indicate that pre-service language teachers in AI learning environments show a high level of metacognitive awareness as indicated through their goal-setting, task prioritization, and efficient resource organization capabilities.

Keywords: metacognitive awareness (MA), pre-service language teachers, self-regulation, learning tool, artificial intelligence (AI), chatbots, thinking strategies.

Introduction

In Kazakhstan, the speed of the development of technological innovations in the educational process is high. Integrating chatbots and artificial intelligence platforms into the educational process offers a unique chance for promoting metacognitive awareness of students and trainee language teachers. Artificial intelligence chatbots (ChatGPT), language learning apps (Grammarly, Duolingo) and educational online platforms (Coursera) have transformed teaching and learning process in the field of language education.

In the present study, we aim to identify how the metacognitive awareness develops pre-service language teachers in AI-based language learning environment. Due to the main purpose, some objectives were identified:

- to consider the concept of metacognitive awareness from a theoretical perspective and determine its importance for future language teachers;
- determining the level of use of AI tools by students and teachers;
- to assess the impact of AI technologies on the learning process of future teachers on their metacognitive strategies;

The research work aims to address following three research questions:

- How frequently do students use AI language learning tools?
- How do AI language learning tools impact on students' metacognitive awareness?

What is the connection between pre-service language teachers' level of metacognitive awareness and their experiences using artificial intelligence platforms for language learning and teaching?

The term «metacognition» was first used by Flavell in the late 1970s [1, p. 1–14]. The concept has continued to develop over the years and has been widely used by several researchers in the field of psychology. Overtime, metacognition has emerged as an important tool in educational research process, especially in the study of thinking processes in educational settings. Due to Brown and Schoenfeld distinguished metacognition into three main components (Figure 1).



Figure 1 – Main components of Metacognition

According to Brown and Schoenfeld, metacognitive skills include planning, monitoring and evaluating learning process [2, p. 1–14]. In addition, metacognitive knowledge requires understanding strategies, tasks and personal learning. Metacognitive experience involves awareness and feelings that arise during learning process [3, p. 165–197].

Within the framework of the concept of metacognition, it is important to clarify the differences between “cognition” and “metacognition”. Cognition is the process of understanding and assimilating certain information, metacognition is the understanding of how a person organizes and manages his or her own learning process [4, p. 155–168].

Metacognitive processes characterize the ability of students and teachers to know, control and regulate their cognitive processes. These skills are important in the educational process, as they determine the ability of future teachers and students to self-regulate, effectively plan learning strategies, monitor and evaluate their own learning. Studying the impact of artificial intelligence tools in education on the development of metacognitive skills is a relevant issue in the field of foreign language education in Kazakhstan.

Recent studies have explored metacognitive awareness among pre-service language teachers, revealing its importance in teachers’ education. Researchers as Ustunbash and Alagozlu, 2021 showed that pre-service teachers generally demonstrate higher levels of knowledge compared to pre-service teachers [5, p. 267–280]. However, Laos & Triprihatmini, 2022, showed that reflective practices can significantly improve teacher education in in-service training [6, p. 2497–2512].

The study by Dilek Cakici, 2018 suggested that educational programs for preparing future teachers should include numerous key elements to develop metacognitive awareness in language learners including curriculum design,

professional development opportunities and collaborative learning environments [7, p. 116-129]. Some studies show that pre-service language teachers tend to demonstrate high level of metacognitive awareness, which can be further improved through targeted training programs [8, p. 365-375]. Moreover, Kamaliasari in 2023 emphasized the role of metacognitive awareness in fostering autonomous learning among students [9, p. 84-95]. Due to this study MA help learners to monitor their learning progress and enhance their learning performances.

These results highlight the importance of incorporating the development of metacognitive skills into teacher education curricula to enhance the quality of teaching and learning experiences.

The study by Feng Teng in 2025, indicate that metacognitive awareness plays a significant role in fostering how EFL learners interact with ChatGPT bots in writing processes. Due to the research article learners with higher metacognitive awareness perceive chatbots as a tool for supporting [10, p. 60]. In addition, learners with high level of metacognitive awareness can analyze and refine AI-generated answers to foster a deeper learning experience, while learners with low level of metacognitive awareness show passive engagement, relying on ChatGPT. However, a specific aspect of EFL learners along this spectrum is metacognitive awareness, which significantly influences their employment of ChatGPT in effective writing based on elite engagement with the model. Having higher metacognitive awareness really affects students' perceptions of ChatGPT as a helpful tool for their own learning and makes them more active in using the tool in their own learning process. They are most likely to evaluate what comes out of ChatGPT critically, figuring out how to integrate it into their writing rather than being content to get pre-packaged answers.

In addition, students with higher levels of metacognitive awareness tend to apply cognitive effort into engaging in ChatGPT-based inquiry. This creates a more dynamic interaction and allows them to employ critical thinking on the ideas offered. This helps not only to strengthen these students' motivation, but to develop their writing confidence as well. According to Wang (2023), such students with higher levels of metacognitive awareness utilize Chat GPT more proactively, purposefully creating specific goals and a thoughtful (critical) judgment of the AI responses, which results in better learning [11, p.283-288]. As metacognitive skills promote self-regulated interaction with educational tools, evidence has established a strong association between metacognitive awareness and effective use of AI tools in academia.

They are also better at regulating their learning strategies such as planning writing, monitoring the writing progress, and critically evaluating the writing. This is crucial for the proper use of AI tools and for fostering autonomous and

innovative thought. Such metacognitive awareness has been recognized as one of the crucial components that shape EFL students' experiences with ChatGPT. This makes it necessary for them to use the tool with caution and it helps them in their journey of improving writing and effectively adding value to their overall learning process.

The Minister of Science and Higher Education of the Republic of Kazakhstan Sayasat Nurbek, 2022 said that to achieve the desired results in the use of artificial intelligence in the educational process, students and teachers should use it responsibly and consciously, observing the ethical standards of using AI [12].

Methods and Materials

A mixed-methods approach was used to study the use of AI-powered tools to foster metacognitive awareness of pre-service language teachers. The quantitative survey was designed to evaluate the respondent's integration of metacognitive awareness skills through AI tools.

The participants of this research work consisted of Al-Farabi Kazakh National University students in Almaty, who were primarily engaged in foreign language learning and teaching. Many respondents were bachelor's degree students and small group were master's degree and doctoral students. A total 100 students were selected. The survey has been distributed with Google Forms to ensure accessibility and ease of participation.

Moreover, research articles from Scopus indexed journals have been reviewed to identify the concept of metacognition and artificial intelligence in language learning and teaching process.

Results and Discussion

The main purpose of the study was to identify the level of metacognitive awareness of pre-service language teachers. The research article analyzed the impact of student's metacognitive abilities in the use of AI-powered tools in language education process. The survey analysis was divided into four main sections and including demographic information, metacognitive awareness in AI learning, planning and goal setting strategies and open-ended questions.

The 100 pre-service language teachers enrolled in the Bachelor, Master and PhD program of language learning and teaching in National, public, and regional universities in Kazakhstan were recruited as subjects.

Figure 2 provides age information about respondents. The age profile of respondents was 67 % under 20 years old, 20 % between 20–25 years old, 10% between 26–30 years old and 3 % over 35 years old.

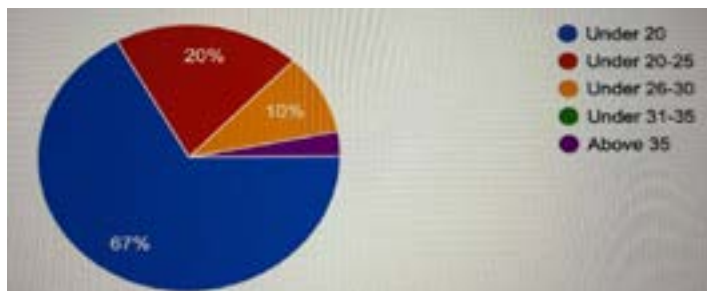


Figure 2 - Age distribution of respondents

All respondents, due to the level of education as shown in Figure 3, a few numbers of respondents 82% had a Bachelor's degree (in progress), while the rest were studying for Master's and Doctoral degree.

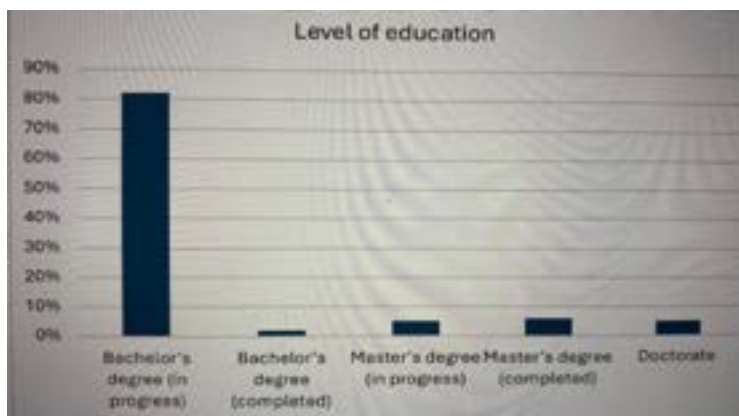


Figure 3 – The level of education

In this study, regarding the first research question about the frequency of AI tools, 33% of respondents answered that they use them daily, and 43% participants use several times a week (Figure 4). This result indicates that AI tools are used regularly by students and teachers. Upon further analysis, it was found that master and PhD respondents were more likely to use these AI tools in their works frequently compared to bachelor degree participants. Such frequency suggests that AI has become an essential educational resource not a supplementary tool.

Firstly, postgraduate students required to deal with more advanced academic assignment work, for example, research, data insights and writing, where advanced instruments are vital to improve their speed and precision. It should become easier in the near future thanks to AI-powered applications like language and chat models, research assistants, and data-processing tools which would further help reduce the tedium of, therefore they are much more attractive to people with higher levels of education.

Second, master's and PhD students are likely to have achieved a stronger degree of digital literacy and research skills, and so have been more familiar with incorporating AI into their workflow. While undergraduate students may still be in what academic writing and research teachers call the narrowing stage of writing – the introductory practice in developing their academic writing and research skills – postgraduates are already looking for ways to optimize their working processes, which they adopt the AI tools extensively.

Moreover, the reliance on AI may vary based on the nature of academic expectations across the levels. Postgraduate students are required to undertake more self-directed study and to conduct original research, which requires extensive reading, synthesis of information, and writing. With support from the model in summarising literature, generating research ideas, and polishing academic writing, AI can be used as a kit when producing an academic product. While the role of AI in syllabus design is undoubtedly valuable, the growing dependence on these tools can lead to cognitive offloading, as users pass off complicated cognitive functions to technology, bypassing thorough critical engagement [13, p. 1–28]. Although it renders the process of writing more efficient, excessive use may still undermine students' acquiring important analytical and problem-solving skills.

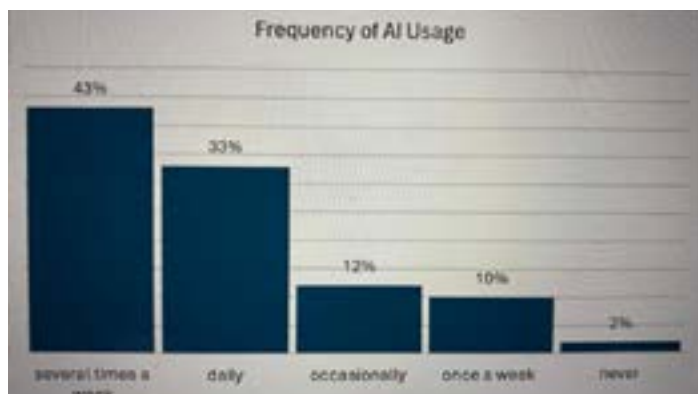


Figure 4 – Frequency of AI Usage

Primary AI tools utilized included language learning apps, chatbots and virtual tutors. IAI language learning tools such as Duolingo (33 %), ChatGPT-based tools (54 %) were recognized as the most popular platforms among future language teachers, while other tools such as Grammarly (4 %) and Coursera (2 %) were used less frequently. Each of these tools can be differentiated due to their features and functions which affect how users engage with the learning materials and assess their understanding.

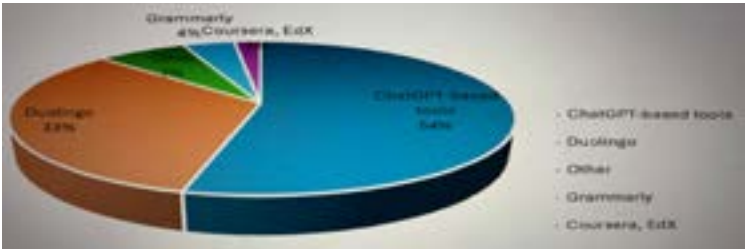


Figure 5 – Number of students using language learning apps

The third section of the conducted survey shows that the implementation of artificial intelligence technologies which helps to improve students’ personalized learning outcomes, planning and goal-setting strategies.

Table 1 divulged that students effectively use AI tools to enhance their learning planning and self-regulation skills. 79 % of participants noted that setting specific learning goals during AI-based lessons and preparation helped them improve their achievements. Moreover, students showed their strengths and weaknesses, selecting effective learning strategies using AI tools. Th analysis showed that 91 % of students believed that AI platforms helped them prioritize depending on their individual needs.

Table 1 – The level of metacognitive awareness in AI learning

№	Questions	Strong-ly agree	Strong-ly disa-gree
1	I set specific learning objectives before starting an AI-powered lesson.	79%	21%
2	I prioritize my learning tasks based on my strengths and weaknesses.	91%	9%
3	I create study schedules or plans when using AI-based learning tools.	68%	32%

4	I create study schedules or plans when using AI-based learning tools.	71 %	29 %
5	I use AI tools to help me organize my learning materials and resources.	79 %	21 %
6	I adjust my learning plan when I encounter difficulties while using AI tools.	67 %	33 %

The integration of AI-powered tools into the educational process has been shown to play a key role in enhancing students' individual learning outcomes. AI tools have become an important tool in strengthening student's self-regulation skills by providing instant feedback and a personalized learning path.

The finding aligns with previous studies indicating that metacognitive awareness is important in language acquisition. Implementation of AI tools in language learning process are crucial for developing these skills. The study's findings demonstrated how students enhance skills of understanding the strategies of learning and performing the tasks, skills of knowing why and when using AI language tools.

Additionally, the results of the study indicated that the use of AI tools in teaching improves students' planning strategies and self-regulation abilities.

Qualitative responses found several themes linking pre-service teachers' degrees of metacognitive awareness with their experiences using artificial intelligence platforms: the majority of respondents (82 %) stated that the real time, instant feedback provided by AI tools aided their comprehension, and provoked self-reflection. Many of them said this feedback was a guide, assisting them in identifying areas that warranted more research. Roughly 70 % of respondents indicated that using AI tools increased their level of engagement, and gave them more of a hands-on, proactive observership of their own learning. Interactive features such as gamification elements and individual learning pathways encouraged them to closely monitor their progress.

The findings are in line with earlier studies emphasizing the importance of metacognitive awareness in language acquisition [14, p. 15–51], the results found imply that pre-service teachers generally believe they can use AI tools to monitor their own understanding.

High AI tool usage frequencies suggest that pre-service teachers are becoming more receptive to AI in educational settings. Moreover, participants confidence in their capacity for self-evaluation is significantly increased by the efficient feedback mechanisms provided by AI tools. Some researchers claim that real-time feedback promotes effective self-regulation [15], learners can quickly assess their comprehension and adjust their tactics in response to immediate feedback.

The frequent use of AI language learning tools by these pre-service language teachers suggests that such tools are likely to be normalized in educational practices over time, and they enable the fostering of metacognitive awareness through repeated engagement with these resources. As pointed out, the metacognitive awareness of the students are highly impacted by AI language learning tools. Implementing these tools can help enhance students' capability to plan, monitor, evaluate, and regulate their learning processes which allows for more in-depth reflection on the part of the student regarding their own learning strategies. As argued in the analysis, AI becomes an important stimulus for the formation of metacognitive skills, which helps students to recognize their strengths/weaknesses in real time and change their learning approaches accordingly.

The results further indicated a significant relationship between pre-service language teachers' general metacognitive awareness levels and the practices of their use in artificial intelligence platforms. Importantly, those more familiar with AI tools demonstrated increased metacognitive abilities, highlighting that AI technology is not only a means to facilitate the learning of languages, but also a means to develop core competencies that will strengthen the functionality of the next generation of language teachers.

Therefore, the reflections of this study suggest some strategies to promote pre-service language teachers metacognitive awareness.

Educator training programs – AI led tools and resources should be integrated across all educator training programs, highlighting its role in developing metacognitive processes. Practical workshops showing how to use these tools effectively can enable teachers in exploiting AI to improve their learning and teaching methodologies. This might include facilitated dialogue and writing prompts encouraging self-regulation and resilience building strategies. There is a need for continuous professional development opportunities for pre-service teachers and educators to improve their understanding and utilization of AI technologies, focusing on metacognitive strategies to improve learning outcomes and promoting autonomous learning.

Conclusion

This research article explored the critical role artificial intelligence plays in fostering metacognitive skills by examining pre-service language teachers' metacognitive awareness in AI-powered language learning environments. The conducted results highlighted the importance of incorporating AI tools into language teaching to improve the self-regulation and effective teaching methods of future language teachers. The consistent use shows that how technology is being more widely adopted and integrated into teaching methods, providing a strong foundation for developing metacognitive awareness through frequent use of these tools.

The integration of artificial intelligence in language learning is an important focus as this research paper discovers the metacognitive awareness of pre-service language teachers in artificial intelligence language learning environments. The results tackle the research questions posed and further elucidate the importance of including AI tools in the language learning environment as a means to foster self-regulation and holistically advocate learning strategies in future language teachers.

One way we can address this is by creating collaborative learning environments whereby pre-service teachers can exchange experiences and strategies associated with the use of AI tools, despite individual variations of metacognitive awareness. Overall, incorporating AI tools in language learning not only facilitates language learning but also serves as a crucial component of future educators' metacognitive abilities. Therefore, with the thoughtful integration of these tools and the advancement of a holistic conception of metacognitive processes, educational institutions can permanently improve the quality of professional development in terms of efficiency and independence of pre-service foreign language teachers.

To guarantee that all pre-service language teachers are capable of using AI tools with confidence, technical competencies ought to be covered in teacher training programs. Furthermore, peer collaborations impact also emphasizes the necessity of social learning opportunities where discussion and shared experiences can enhance the language learning environment.

In conclusion, the findings highlight how AI tools can help pre-service language teachers become more metacognitive while highlighting areas that require improvement. The overall metacognitive awareness level of pre-service language teachers in AI learning environments seem to be strong, underscored by their ability to set objectives, prioritize tasks, and organize resources effectively. According to the study, increased usability training and the integration of collaborative activities may further empower pre-service teachers effectively use AI tools. In order to develop a more flexible and responsive approach in pre-service teachers and enhance their teaching abilities in a constantly changing educational environment, educational programs should concentrate on supporting these adaptive learning practices going forward. Future studies should investigate long-term impacts and explore particular AI tools utilized in diverse educational settings.

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Received 06.04.25

Received in revised form 02.12.25

Accepted for publication 05.05.26

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06.04.25 ж. баспаға түсті.

02.12.25 ж. түзетулерімен түсті.

05.05.26 ж. басып шығаруға қабылданды.

ЖАСАНДЫ ИНТЕЛЛЕКТ НЕГІЗІНДЕ ТІЛ ҮЙРЕНУ ОРТАСЫНДАҒЫ БОЛАШАҚ ШЕТЕЛ ТІЛІ ПӘНІ МҰҒАЛІМДЕРІНІҢ МЕТАТАНЫМДЫҚ ХАБАРДАРЛЫҒЫ

Бұл мақалада жасанды интеллект (ЖИ) негізінде тілді оқыту контекстінде болашақ шетел тілі мұғалімдерінің метатанымдық хабардарлығы қарастырылады. Болашақ шетел тілі пәні мұғалімдерінің өзін-өзі реттейтін оқу мен сыни ойлауын қалыптастыруды жеңілдетудегі ЖИ рөлі, сондай-ақ инновациялық рефлексиялық оқыту тәжірибесі зерттеледі. Соңғы жылдары шетел тілін үйренуде ЖИ құралдарын кеңінен пайдалану осы саладағы зерттеудің негізгі бағыттарының біріне айналды. Зерттеудің маңыздылығы ЖИ технологияларын заманауи білім беру үдерісіне белсенді түрде енгізумен және олардың метатанымдық дағдыларды дамытудағы әлеуетінен көрінеді. Мақаланың мақсаты – болашақ шетел тілі пәні мұғалімдерінің оқу үдерісін жоспарлау, бақылау, бағалау және реттеуін зерттеу және шетел тілі мұғалімдерінің метатанымдық дағдыларын дамытудағы ЖИ рөлін анықтау. Зерттеуде аралас әдістер қолданылды, сауалнама арқылы сандық деректер жинақталды және тіл үйренудегі метатаным мен ЖИ-дің рөлі туралы әдебиеттерге шолу жасалды. Зерттеу жұмысы

әл-Фараби атындағы Қазақ ұлттық университетінің 100 болашақ шетел тілі пәні мұғалімдері арасында жүргізілді. Сауалнама Google Forms көмегімен алынды. Нәтижелер студенттердің ЖИ құралдарын жиі пайдаланатынын және бұл құралдар олардың өзін-өзі реттеу дағдыларына оң әсер ететінін анықтады. Тәжірибе метатанымдық стратегиялардың икемді және бейімделгіш болуы тиіс және жасанды интеллект нәтижесіне оқытуда маңызды рөл атқара алатынын көрсетті. Бұл аспектілерді түсіну мұғалімдердің білім беру бағдарламалары үшін өте маңызды, сондықтан болашақ мұғалімдер технологияны шебер қолданып қана қоймай, сонымен қатар, студенттерге білім алудағы өзін-өзі реттеу және ойлау стратегияларын қолдану дағдыларын сіңіре алады. Тұтастай алғанда, мақсат қою, тапсырмадағы басымдықтарды айқындау және ресурстарды тиімді ұйымдастыру мүмкіндіктері арқылы анықталған нәтижелер ЖИ негізіндегі тіл оқыту ортасының көмегімен болашақ шетел тілі пәні мұғалімдерінің метатанымдық хабардарлық деңгейінің жоғары бола алатындығын көрсетеді.

Кілтті сөздер: метатанымдық хабардарлық (МХ), болашақ шетел тілі пәні мұғалімдері, өзін-өзі реттеу, инструменталды оқыту, жасанды интеллект (ЖИ), чатбот, ойлау стратегиясы.

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Поступило в редакцию 06.04.25

Поступило с исправлениями 02.12.25

Принято в печать 05.05.26

МЕТАКОГНИТИВНАЯ ОСВЕДОМЛЕННОСТЬ БУДУЩИХ УЧИТЕЛЕЙ ИНОСТРАННЫХ ЯЗЫКОВ С ПОМОЩЬЮ СРЕД ОБУЧЕНИЯ ЯЗЫКУ НА ОСНОВЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА

Данная статья посвящена изучению метакогнитивной осведомленности будущих учителей иностранных языков в контексте изучения языка с помощью ИИ. В ней исследуется роль ИИ в содействии саморегулируемому обучению и критическому мышлению, а также инновационной рефлексивной практике преподавания будущих студентов в учителя. Использование

инструментов искусственного интеллекта (ИИ) для изучения языка в широком смысле стало одним из ключевых направлений исследований в последние годы. Значимость исследования обусловлена активным внедрением технологий ИИ в современный образовательный процесс и их потенциалом в развитии метакогнитивных навыков. Цель данного исследования – изучить планирование, мониторинг, оценку и регуляцию учебного процесса учителями иностранных языков, а также определить роль ИИ в развитии метакогнитивных навыков учителей иностранных языков. Использован смешанный метод, в рамках которого собран количественные данные с помощью опроса и проведен обзор научной литературы о роли метакогнитивных и ИИ в обучении языку. Исследование было проведено среди 100 будущих студентов иностранных языков Казахского национального университета им. аль-Фараби. Опрос проводился с помощью Google Forms. Результаты показывают, что студенты довольно часто используют инструменты искусственного интеллекта, и эти инструменты оказывают положительное влияние на их навыки саморегуляции. Такая практика подчеркивает, что метакогнитивные стратегии должны быть гибкими и адаптивными, а искусственный интеллект может сыграть решающую роль в эффективном преподавании. Понимание этих аспектов крайне важно для программ педагогического образования, чтобы будущие учителя могли не только умело использовать технологии, но и прививать ученикам навыки использования стратегий саморегуляции и мышления. Полученные результаты свидетельствуют о том, что преподаватели иностранных языков в среде обучения с использованием ИИ демонстрируют высокий уровень метакогнитивной осведомленности, о чем свидетельствуют их способности к постановке целей, определению приоритетности задач и эффективной организации ресурсов.

Ключевые слова: метакогнитивная осведомленность (МО), будущие учителя иностранных языков, саморегуляция, инструмент обучения, искусственный интеллект (ИИ), чатботы, стратегии мышления.

Теруге 15.05.2026 ж. жіберілді. Басуға 30.06.2026 ж. қол қойылды.

Электронды баспа

26,3 Кб RAM

Шартты баспа табағы 50,81

Таралымы 300 дана. Бағасы келісім бойынша.

Компьютерде беттеген З. Ж. Шокубаева

Корректорлар: А. Р. Омарова, Д. А. Кожас

Тапсырыс № 4566

Сдано в набор 15.05.2026 г. Подписано в печать 30.06.2026 г.

Электронное издание

26,3 Кб RAM

Усл.п.л. 50,81. Тираж 300 экз. Цена договорная.

Компьютерная верстка З. Ж. Шокубаева

Корректоры: А. Р. Омарова, Д. А. Кожас

Заказ № 4566

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