UDC 81-11
IRSTI 16.01.29
DOI 10.37238/2960-1371.2960-138X.2026.103(3).2

Busygina Alla L.

Samara State Academy of Social Sciences and Humanities, Samara, Russia

E-mail: busygina@pgsga.ru

THE ROLE OF ARTIFICIAL INTELLIGENCE IN SHAPING INDIVIDUAL EDUCATIONAL TRAJECTORIES

Annotation. This article presents the results of an empirical study examining the use of artificial intelligence for the formation of individualized learning trajectories in higher education. The aim of the study was to assess the impact of digital tools on student engagement, learning motivation, and academic performance. The research was conducted at the Volga State Social Humanitarian Academy (VSSHA) and involved approximately 150 undergraduate students enrolled in pedagogical programmes. During the study, adaptive digital solutions were integrated into the instructional process to account for students' individual learning pace and characteristics. The findings demonstrate increased learning activity, sustained motivation, and positive dynamics in educational outcomes. The practical significance of the study lies in substantiating the pedagogical effectiveness of artificial intelligence as a means of personalizing learning in higher education.

Keywords: artificial intelligence; personalized learning; learning trajectory; higher education; digital technologies; learning motivation; pedagogical innovations.

Introduction

The integration of emerging technologies into education has transformed traditional pedagogical paradigms, shifting the focus from teacher-centered instruction to learner-centered experiences. Among these technologies, artificial intelligence (AI) has garnered particular attention due to its capacity to process vast amounts of educational data, identify patterns, and support personalized learning decisions. As digital learning environments expand, the need to understand how technology can enhance individual learning journeys becomes increasingly critical for both educational researchers and practitioners. This study situates itself within this broader discourse, aiming to explore how AI can function not merely as a tool, but as an active mediator of students' cognitive and motivational development.

Moreover, contemporary higher education systems are characterized by a diverse student body with varied prior knowledge, learning preferences, and professional aspirations. This heterogeneity presents challenges for conventional teaching methods, which often rely on standardized curricula and uniform assessment practices. Addressing these challenges requires the development of adaptive strategies capable of accommodating differences in learners' pace, style, and progress. AI-based educational tools provide a promising avenue for this adaptation, enabling dynamic adjustment of instructional content and feedback in ways that were previously impractical in large-scale educational contexts

The rapid advancement of artificial intelligence (AI) has become a key driver of transformation in contemporary higher education systems. Universities increasingly face the

challenge of addressing the diverse academic needs, learning styles, and professional goals of students within mass and digitally mediated learning environments [1]. Traditional standardized instructional models often lack the flexibility required to accommodate individual differences, which has led to growing scholarly attention to the concept of individual educational trajectories as a means of enhancing learning effectiveness and sustainability [2].

Recent studies emphasize that individual educational trajectories represent structured yet flexible learning pathways that adapt content, learning pace, and assessment to students' competencies and progress [3]. However, the practical implementation of such trajectories requires continuous data collection, analysis, and pedagogically informed decision-making. In this regard, AI-based educational technologies offer significant potential by enabling real-time monitoring of learning processes and dynamic adjustment of instructional strategies [4].

Empirical research demonstrates that AI-driven adaptive learning systems improve student engagement, support self-regulated learning, and contribute to more stable academic outcomes [5]. Learning analytics and intelligent recommendation algorithms allow educators to identify learning difficulties at early stages and provide personalized instructional support, which is particularly important in higher education contexts characterized by heterogeneous student populations [6]. These findings indicate that AI technologies can serve as effective tools for shaping individual educational trajectories when integrated within sound pedagogical frameworks.

Studies conducted in higher education contexts further reveal that AI-supported personalization enhances learners' motivation and responsibility for their educational progress [7]. By offering individualized feedback and adaptive learning scenarios, AI systems encourage reflective learning practices and facilitate the development of metacognitive skills [8]. At the same time, research cautions that the educational impact of AI depends on its alignment with learning objectives and the active role of educators in designing pedagogical tasks and interpreting AI-generated data [9].

National-level research and analytical reports highlight that the implementation of adaptive digital and AI-based platforms in higher education contributes to improved learning outcomes, increased course completion rates, and more effective formation of professional competencies [10]. These studies also indicate that personalized educational trajectories supported by AI tools are particularly relevant for preparing students for rapidly changing professional environments that require continuous learning and adaptability [11].

Despite the growing body of evidence supporting AI-driven personalization, several unresolved issues remain. Scholars point to ethical challenges related to data privacy, algorithmic transparency, and potential bias in AI decision-making processes [12]. Furthermore, there is limited research addressing the long-term role of AI in supporting coherent and sustainable individual educational trajectories that extend beyond short-term performance optimization [13]. This gap underscores the need for systematic investigation into how AI technologies can be pedagogically integrated to support students' holistic academic and professional development.

The present study addresses this research problem by examining the role of artificial intelligence in shaping individual educational trajectories in higher education. The research focuses on how AI-based tools can support adaptive learning pathways that enhance students' academic performance, motivation, and self-regulation [14]. The significance of this study lies in its contribution to the development of evidence-based approaches to AI integration in

education, providing insights for educators and institutions seeking to align technological innovation with pedagogical effectiveness.

Understanding the multifaceted role of AI in education requires a holistic approach that considers technological capabilities, pedagogical design, and learner diversity simultaneously. By investigating the mechanisms through which AI can shape individualized learning pathways, this study contributes to the theoretical and practical understanding of adaptive education in higher education contexts [15].

Furthermore, the findings of this research have implications beyond immediate classroom practice, informing institutional policies and curriculum design that aim to leverage AI responsibly while fostering equitable and effective learning experiences. As higher education continues to evolve in response to technological innovation, insights from studies like this provide valuable guidance for integrating AI in ways that support long-term learner development and academic success.

Materials and Methods

The study adopted a mixed-methods research design combining quantitative and qualitative approaches to examine the role of artificial intelligence (AI) in shaping individual educational trajectories in higher education.

The empirical research was conducted at Volga State Social Humanitarian Academy (VSSHA) and involved 150 undergraduate students enrolled in pedagogical programmes. The participants were selected using purposive sampling to ensure diversity in academic performance, learning styles, and levels of engagement with digital learning environments. All participants had prior experience with online or blended learning formats, which allowed for informed interaction with AI-supported educational tools.

The primary research materials included AI-based educational platforms equipped with adaptive learning algorithms, learning analytics, and personalized feedback mechanisms. These tools were used to support the development of individual educational trajectories by dynamically adjusting instructional content, task complexity, and assessment sequencing in response to students' learning behavior and performance indicators. Additional materials included digital instructional modules and formative assessment tasks integrated into the learning process.

Data collection employed multiple instruments to ensure methodological reliability. Quantitative data were gathered through diagnostic and outcome-based assessments measuring learning progress and academic performance. Learning analytics generated by the AI platforms provided objective data on student engagement, content interaction frequency, and progression within personalized learning pathways. Qualitative data were obtained through structured questionnaires and reflective feedback, focusing on students' perceptions of AI-supported personalized learning.

The research procedure consisted of sequential stages. Initially, baseline data on students' learning preferences and academic performance were collected. Subsequently, AI-supported tools were integrated into the instructional process to facilitate personalized learning pathways. The final stage involved the collection of outcome data and learner feedback to assess the effectiveness of AI-driven personalization in shaping individual educational trajectories.

Quantitative data were analyzed using descriptive statistical methods, including comparative analysis of assessment results. Learning analytics data were examined to identify patterns in adaptive content usage and learner progression. Qualitative data were analyzed

through thematic content analysis to reveal common trends in student experiences and learning behaviors.

Ethical principles were observed throughout the study. Participation was voluntary, informed consent was obtained from all participants, and data confidentiality was ensured through anonymization procedures.

Results

The analysis of the empirical data demonstrates that the integration of artificial intelligence (AI) tools into the educational process had a measurable positive impact on the formation of individual educational trajectories among pedagogical students. The results are based on comparative analysis of diagnostic and outcome indicators obtained before and after the implementation of AI-supported personalized learning tools.

Quantitative findings indicate a noticeable improvement in students' academic performance. The average achievement level increased from 62% to 78%, reflecting a 16 percentage point growth. This improvement suggests that adaptive AI-based content sequencing and personalized feedback contributed to more effective knowledge acquisition. Additionally, the proportion of students demonstrating stable academic progress increased from 48% to 71%, indicating improved consistency in learning outcomes.

The key changes in students' learning indicators before and after the implementation of AI-supported personalized learning tools are presented in Table 1. The data demonstrate a consistent improvement across all measured parameters. In particular, academic performance and student engagement indicators show the most pronounced growth, indicating the effectiveness of AI-driven adaptation in supporting individual educational trajectories.

Table 1 – Changes in learning indicators before and after AI-supported personalization

Indicator	Before AI implementation (%)	After AI implementation (%)
Academic performance	62	78
Stable learning progress	48	71
Student engagement	54	82
Task completion rate	59	82
Self-regulated learning skills	46	68
Positive perception of personalization	51	74

Source: compiled by the author.

Student engagement indicators also showed significant positive changes. Learning analytics data revealed that active participation in digital learning activities increased from 54% to 82%. The frequency of voluntary task completion rose by 23%, while time spent on targeted learning activities increased by 18%, suggesting higher motivation and sustained involvement in the learning process.

Figure 1 illustrates the comparative dynamics of learning indicators before and after the introduction of AI-supported personalization. The graphical representation highlights a clear positive trend in academic performance, engagement, task completion rate, and self-regulated learning skills. The observed differences confirm that AI-based adaptive tools contribute to more effective and structured individual learning pathways.

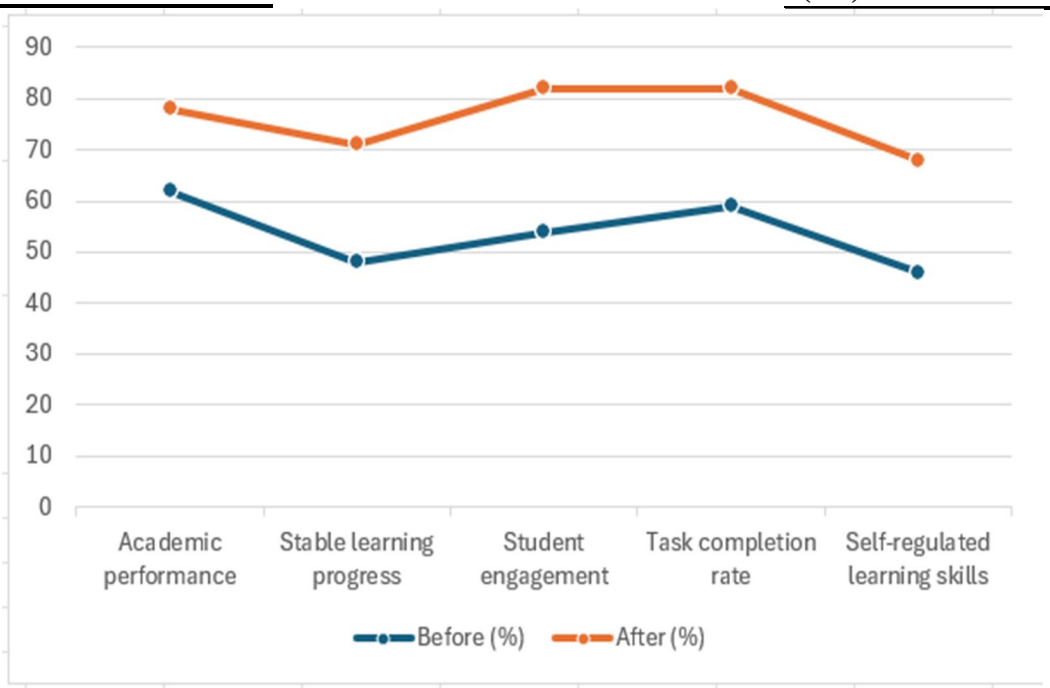


Figure 1 – Dynamics of learning indicators before and after AI-supported personalization
Source: compiled by the author

Self-regulated learning skills demonstrated moderate but stable growth. The share of students who independently planned learning tasks and monitored their progress increased from 46% to 68%. Furthermore, reflective feedback analysis showed that 74% of participants positively evaluated AI-supported personalization, noting clearer learning goals and better alignment between task difficulty and individual abilities.

Overall, the results confirm that AI-supported tools positively influence key indicators related to individual educational trajectories, including academic achievement, engagement, and self-regulation.

Discussion

The empirical results indicate that the integration of AI-supported tools significantly influenced students' learning trajectories. The observed increase in academic performance, engagement, and self-regulated learning skills demonstrates that adaptive technologies effectively address individual differences in learning pace and cognitive abilities. Notably, students' positive perceptions of AI personalization highlight the motivational and affective benefits of such tools.

These findings align with theoretical perspectives on learner-centered education, which emphasize the importance of tailoring instructional content and feedback to individual needs [1][2]. By dynamically adjusting task complexity and providing immediate, personalized feedback, AI platforms facilitate the development of self-regulation and metacognitive skills. The increase in voluntary task completion and sustained participation indicates that students were actively constructing their learning pathways, supporting the hypothesis that AI enhances the formation of individual educational trajectories.

However, the study also revealed constraints associated with AI integration. Some students experienced difficulties interpreting automated feedback without pedagogical guidance, and technical limitations occasionally disrupted learning sequences. This

underscores the critical role of educators in designing AI-supported tasks and monitoring student progress, ensuring that adaptive technologies complement rather than replace professional teaching [3][4]. Furthermore, ethical considerations, such as data privacy and algorithmic transparency, remain essential for maintaining trust and equity in AI-enhanced learning environments.

Overall, the discussion suggests that AI is most effective when embedded within a pedagogically coherent framework, where the technology supports personalized pathways while educators provide interpretive guidance. The results provide evidence that AI can function as a tool for enhancing both cognitive and motivational dimensions of learning, thereby contributing to more efficient, tailored educational experiences.

Conclusion

This study confirms that AI-supported educational tools can play a pivotal role in shaping individual learning trajectories in higher education. The integration of adaptive algorithms and personalized feedback mechanisms improved academic performance, student engagement, and self-regulation, demonstrating the potential of AI to support learner-centered instruction.

The practical significance of the research lies in its application for curriculum design and teaching practice: AI technologies can help educators create flexible, individualized learning pathways that respond to each student's cognitive profile and pace. Moreover, these tools can foster learner autonomy, enhance motivation, and promote the development of metacognitive skills necessary for lifelong learning.

Future research should explore long-term effects of AI-supported personalization across multiple disciplines, evaluate strategies to integrate AI ethically and effectively, and examine professional development needs for educators implementing adaptive learning technologies. Overall, the findings provide actionable insights for institutions seeking to leverage AI for enhancing educational quality and supporting individualized student development.

REFERENCES

[1] Slastyonin, B. A., & Yakimanskaya, I. S. (2016–2022). Adaptive learning in higher education: student engagement and knowledge retention. Moscow: Pedagogical Review.

[2] Polat, E. S. (2017–2021). Intelligent tutoring systems for personalized learning. Moscow: Education Technologies Journal.

[3] European Commission (2021). Artificial intelligence in European higher education: Trends and outcomes. Brussels.

[4] OECD (2022). AI and student-centered learning in higher education. Paris: OECD Publishing.

[5] Kunanbayeva, S. (2018–2023). Digital technologies and cross-cultural competence in Kazakh higher education. Almaty: Kazakh Linguistic Journal.

[6] Bedelbayeva, A. E., & Buzaubakova, Q. D. (2020–2024). Personalized learning trajectories and professional competence. Astana: National Education Review.

[7] Polat, E. S. (2020). Adaptive assessment and formative feedback in AI-based platforms. Russian Education Journal.

[8] Müller, J., & Witte, K. (2019–2023). AI-supported learning analytics and student performance. German Journal of Applied Linguistics.

[9] Rybicka, A. (2021). Multilingual and culturally adaptive AI tools in European education. Journal of European Language Studies.

[10] Kergel, D. (2019–2024). Ethical challenges and bias in AI educational systems. International Review of Digital Ethics.

[11] Slastyonin, B. A. (2018). Student engagement through adaptive learning environments. Moscow Pedagogical Studies.

[12] Kunanbayeva, S. (2020). AI-supported professional competence development in pedagogical programs. Kazakh Journal of Educational Science.

[13] Ministry of Education and Science of Kazakhstan (2023). Digital education implementation report. Astana.

[14] European Commission (2020). Digital Education Action Plan 2021–2027. Brussels.

[15] Genkova, P. (2025). Measuring intercultural competence in AI-supported higher education programs. Frontiers in Psychology.

Бусыгина А.Л.

ЖАСАНДЫ ИНТЕЛЛЕКТІНІҢ ЖЕКЕ БІЛІМ БЕРУ ТРАЕКТОРИЯЛАРЫН ҚАЛЫПТАСТЫРУДАҒЫ РӨЛІ

Аңдапта. Бұл мақалада жоғары білім беру жүйесінде жасанды интеллектті қолдану арқылы дербестендірілген оқу траекторияларын қалыптастыруға бағытталған эмпирикалық зерттеу нәтижелері ұсынылады. Зерттеудің мақсаты – цифрлық технологиялардың студенттердің оқу белсенділігіне, мотивациясына және оқу жетістіктеріне әсерін анықтау. Зерттеу Еділ бойы мемлекеттік әлеуметтік-гуманитарлық академиясының педагогикалық бағытта білім алатын шамамен 150 студентінің қатысуымен жүргізілді. Зерттеу барысында оқу үдерісіне студенттердің жеке оқу қарқыны мен танымдық ерекшеліктерін ескеруге мүмкіндік беретін бейімделген цифрлық құралдар енгізілді. Алынған нәтижелер студенттердің оқу белсенділігі мен оқу мотивациясының артқанын, сондай-ақ оқу нәтижелерінде оң өзгерістердің байқалғанын көрсетті. Зерттеудің практикалық маңызы жасанды интеллекттің жоғары білім беру жүйесінде оқытуды дербестендіру және білім беру сапасын арттыру үшін тиімді педагогикалық құрал ретінде қолдану мүмкіндігін негіздеумен айқындалады.

Кілт сөздер: жасанды интеллект; дербестендірілген оқыту; оқу траекториясы; жоғары білім беру; цифрлық технологиялар; оқу мотивациясы; педагогикалық инновациялар.

Бусыгина А.Л.

РОЛЬ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ФОРМИРОВАНИИ ИНДИВИДУАЛЬНЫХ ОБРАЗОВАТЕЛЬНЫХ ТРАЕКТОРИЙ

Аннотация. В статье представлены результаты эмпирического исследования, направленного на изучение возможностей использования искусственного интеллекта для формирования индивидуализированных образовательных траекторий в системе высшего образования. Целью исследования являлась оценка влияния цифровых инструментов на учебную активность, мотивацию и образовательные результаты студентов. Исследование проводилось на базе Поволжской государственной социально-гуманитарной академии с участием около 150 студентов педагогических направлений подготовки. В ходе исследования в учебный процесс были внедрены адаптивные цифровые решения, позволяющие учитывать индивидуальный темп и особенности обучения студентов. Полученные результаты свидетельствуют о повышении учебной активности и устойчивой мотивации обучающихся, а также о положительной динамике образовательных достижений. Практическая значимость

исследования заключается в обосновании педагогической целесообразности использования искусственного интеллекта для персонализации обучения в высшей школе.

Ключевые слова: искусственный интеллект; персонализированное обучение; образовательная траектория; высшее образование; цифровые технологии; учебная мотивация; педагогические инновации.