

Olga Vorfolomeyeva,¹ Dina Aitkalieva,¹ Roza Abuova,¹
Lyazzat Kazhenova,¹ Saltanat Tabyldiyeva¹

¹*Makhambet Utemisov West Kazakhstan University (Uralsk, Republic of Kazakhstan)*

Artificial Intelligence as a Catalyst for Innovation in the Educational Space and Strategic Vectors of Its Development

DOI: 10.30819/cmse.10-0.04

ABSTRACT

This study explores the strategic integration of artificial intelligence (AI) into Kazakhstan's educational system, focusing on its impact on personalised learning, intelligent tutoring, and administrative optimisation. Using a systematic literature review, comparative analysis of pedagogical models, and content analysis of regulatory frameworks, the study identifies three key vectors for AI development: adaptive-personalised learning, collaborative educator-technology interaction, and administrative-analytical optimisation. Findings show that AI enhances academic performance, reduces learning time, and increases learner engagement, particularly in subjects requiring adaptive content and interactivity. The study highlights the importance of a balanced integration strategy, where AI supports pedagogy rather than replacing it, and emphasises the need for robust digital infrastructure and teacher professional development. It also identifies challenges in AI adoption between urban and rural schools in Kazakhstan. The research contributes a multidimensional framework for evaluating AI integration and provides strategic recommendations for its sustainable implementation within national educational systems.

KEY WORDS

Digital transformation, personalised learning, educational technologies, multi-parametric model, statistical analysis, pedagogical innovations

Paper received: 24 December 2025 • Paper revised: 6 February 2026 • Paper accepted: 20 March 2026

About authors

Olga Vorfolomeyeva [0000-0003-4231-9477] is a Senior Lecturer, PhD at the Faculty of Culture and Arts, Makhambet Utemisov West Kazakhstan University, Uralsk, Republic of Kazakhstan.
Email: olgavorfolomeyeva@gmail.com

Dina Aitkalieva [0009-0001-8741-2221] is an Associate Professor, PhD at the Faculty of Culture and Arts, Makhambet Utemisov West Kazakhstan University, Uralsk, Republic of Kazakhstan.
Email: d.aitkalieva@outlook.com

Roza Abuova [0009-0007-1028-7438] is a Senior Lecturer, Master at the Faculty of Culture and Arts, Mak-hambet Utemisov West Kazakhstan University, Uralsk, Republic of Kazakhstan.
Email: rabuova@hotmail.com

Lyazzat Kazhenova [0009-0003-5532-9751] is a Senior Lecturer at the Faculty of Culture and Arts, Mak-hambet Utemisov West Kazakhstan University, Uralsk, Republic of Kazakhstan.
Email: l-kazhenova@outlook.com

Saltanat Tabyldiyeva [0009-0000-4812-9901] is a Senior Lecturer at the Faculty of Culture and Arts, Mak-hambet Utemisov West Kazakhstan University, Uralsk, Republic of Kazakhstan.
Email: s_tabyldiyeva@hotmail.com

References

- Abdrakhmanov, R., Zhaxanova, A., Karatayeva, M., Niyazova, G. Z., Berkimbayev, K., & Tuimebayev, A. (2024). Development of a framework for predicting students' academic performance in STEM education using machine learning methods. *International Journal of Advanced Computer Science and Applications*, 15(1), 38–46.
- AI in education ethics framework (2023). Available at: <https://www.learning.moe.edu.sg/ai-in-sls/responsible-ai/ai-in-education-ethics-framework/> (accessed 23 February 2026).
- Akshataeva, Z., Baizhanova, K., Beisebaeva, S., Sherimkulova, G., Nurahmetova, G., & Khamzina, Z. (2016). The framework of social security system public management in Kazakhstan. *International Journal of Environmental and Science Education*, 11(18), 11645–11657.
- Akyzbekova, N., Zhakshylykova, K., Mukambaeva, I., Omurova, S., & Attokurova, A. (2025). Digital technologies as a catalyst for training high-demand specialists: New opportunities for education and the labour market. *Bulletin of the Jusup Balasagyn Kyrgyz National University*, 17(1), 9–19.
- Amer-Yahia, S. (2022). Towards AI-powered data-driven education. *Proceedings of the VLDB Endowment*, 15(12), 3798–3806.
- Barlybayev, A., & Turginbayeva, A. (2025). Development and implementation of an advanced fuzzy expert system for the assessment of information security risks. *Journal of Computational and Cognitive Engineering*, 4(4), 570–580.
- Bazaluk, O. (2019). Plato's traditions in modern educational theories. *Analele Universitatii din Craiova, Seria Filozofie*, 43(1), 5–20.
- Bazyl, O., Abilova, O., Karpenko, O., Mierienkov, H., & Poliakova, A. (2025). Assessing the impact of artificial intelligence integration on educational processes in higher education institutions of Ukraine and Kazakhstan. *Sustainable Engineering and Innovation*, 7(1), 97–116.
- BBC StoryWorks (2024). Harnessing the power of AI with a distinctively Kazakh touch. Available at: <https://www.bbc.com/storyworks/kazakhstan-connection/harnessing-the-power-of-ai-with-a-distinctively-kazakh-touch> (accessed 23 February 2026).
- Camacho Ibáñez, J., & Villas Olmeda, M. (2021). Operationalising AI ethics: How are companies bridging the gap between practice and principles? An exploratory study. *AI & Society*, 37(4), 1663–1687.
- Chandhok, V., & Singh, G. (2024). The evolution of learning: A survey of AI technologies in education. *International Journal of Advanced Research*, 12(4), 491–495.
- China's "New Generation Artificial Intelligence Development Plan" (2017). Available at: <https://digichina.stanford.edu/work/full-translation-chinas-new-generation-artificial-intelligence-development-plan-2017/> (accessed 23 February 2026).
- Concept of Artificial Intelligence Development for 2024–2029 (2024). Available at: <https://adilet.zan.kz/rus/docs/P2400000592#z10> (accessed 23 February 2026).
- EU Artificial Intelligence Act (2024). Available at: <https://artificialintelligenceact.eu/> (accessed 23 February 2026).
- Eurasian Science Review (2024). Innovations in Kazakhstan's education. Available at: <https://eurasia-science.org/index.php/pub/article/view/77> (accessed 23 February 2026).

- Family Educational Rights and Privacy Act (1974). Available at: <https://studentprivacy.ed.gov/ferpa/> (accessed 23 February 2026).
- General Data Protection Regulation (2016). Available at: <https://gdpr-info.eu/> (accessed 23 February 2026).
- Giang, N. T., Dinh, N. V., Ngu, P. N. H., Chau, D. B., Thao, N. P., & Thao, T. T. P. (2025). Applying augmented reality technology in STEM education: A bibliometrics analysis in Scopus database. *European Journal of Educational Research*, 14(1), 73–87.
- Holmes, W., Porayska-Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Shum, S. B., Santos, O., Rodrigo, M. T., Cukurova, M., Bittencourt, I., & Koedinger, K. (2021). Ethics of AI in education: Towards a community-wide framework. *International Journal of Artificial Intelligence in Education*, 32(3), 504–526.
- How, M. L., & Hung, W. L. D. (2019). Educing AI-thinking in science, technology, engineering, arts, and mathematics (STEAM) education. *Education Sciences*, 9(3), 184.
- Institute of Smart Systems and Artificial Intelligence (ISSAI) (2024). AI for Kazakh language. Available at: <https://issai.nu.edu.kz/ai-for-kazakh/> (accessed 23 February 2026).
- International Organisation for Standardisation (2023). ISO/IEC 42001:2023 “Information technology – Artificial intelligence – Management system”. Available at: <https://www.iso.org/standard/81230.html> (accessed 23 February 2026).
- Internet Information Service Algorithmic Recommendation Management Provisions (2022). Available at: <https://digichina.stanford.edu/work/translation-internet-information-service-algorithmic-recommendation-management-provisions-effective-march-1-2022/> (accessed 23 February 2026).
- Karelkhan, N., & Uderbayeva, N. (2024). The effectiveness of using virtual and augmented reality technologies for teaching computer science in schools. *International Journal of Information and Education Technology*, 14(11), 1566–1573.
- Kazakhstan Digital Acceleration for an Inclusive Economy (DARE) Project (2024). Available at: <https://projects.worldbank.org/en/projects-operations/project-detail/P179204> (accessed 23 February 2026).
- Kenzhegalieva, S. (2025). The effectiveness of using the artificial intelligence (ChatGPT) project in the new century. *Eurasian Science Review: An International Peer-Reviewed Multidisciplinary Journal*, 1(3), 2502–2514.
- Khan, A., Badshah, S., Liang, P., Khan, B., Waseem, M., Niazi, M., & Akbar, M. (2021). Ethics of AI: A systematic literature review of principles and challenges. In: *Proceedings of the 26th International Conference on Evaluation and Assessment in Software Engineering (EASE '22)* (pp. 383–392). Association for Computing Machinery.
- Kwilinski, A., Merritt, P., & Wróblewski, Ł. (2024). Advancing sustainable development goals through digital culture: A global research overview. *Cultural Management: Science and Education*, 8 (1), 61-80.
- Law of the Republic of Kazakhstan No. 103-VIII “On Science and Technological Policy” (2024). Available at: <https://adilet.zan.kz/eng/docs/Z2400000103> (accessed 23 February 2026).
- Li, M., Enkhtur, A., Cheng, F., & Yamamoto, B. A. (2023). Ethical implications of ChatGPT in higher education: A scoping review. *Journal of Interdisciplinary Studies in Education*, 13(1), 55–68.
- Lin, Z. (2023). Why and how to embrace AI such as ChatGPT in your academic life. *Royal Society Open Science*, 10(8), 230658.
- Ministry of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan (2017). “Digital Kazakhstan” state program. Available at: <https://www.gov.kz/memleket/entities/mdai/activities/14764?lang=ru> (accessed 23 February 2026).
- National Institute of Standards and Technology (2023). Artificial Intelligence Risk Management Framework. Available at: <https://www.nist.gov/itl/ai-risk-management-framework> (accessed 23 February 2026).
- OECD (2023). Artificial intelligence in education: Policy considerations. Available at: <https://www.oecd.org/education/ai-in-education-policy.htm> (accessed 23 February 2026).
- OECD.AI (2024). Kazakhstan AI policies dashboard. Available at: <https://oecd.ai/en/dashboards/>

- countries/Kazakhstan/ (accessed 23 February 2026).
- Owoc, M., Sawicka, A., & Weichbroth, P. (2021). Artificial intelligence technologies in education: Benefits, challenges and strategies of implementation. *Artificial Intelligence for Knowledge Management. IFIP Advances in Information and Communication Technology*, 599, 37–58.
- Personal Information Protection Law of the People's Republic of China (2021). Available at: <https://digichina.stanford.edu/work/translation-personal-information-protection-law-of-the-peoples-republic-of-china-effective-nov-1-2021/> (accessed 23 February 2026).
- QAZAQ AI (2024). Available at: https://qazaq.ai/en_US/ (accessed 23 February 2026).
- Rakhmetullina, Z., Soltan, G., Mukasheva, R., Zunimova, G., Mukhamedova, R., & Tezekpayeva, S. (2021). Functional and architectural solution of a software package for the analysis of educational data. In: 2021 International Congress of Advanced Technology and Engineering, ICOTEN 2021 (p. 9493505). Institute of Electrical and Electronics Engineers.
- Report on the Implementation of the Development Plan of the Ministry of Education of the Republic of Kazakhstan for 2024–2027 (2024). Available at: <https://www.gov.kz/memleket/entities/edu/documents/details/785001?lang=ru> (accessed 23 February 2026).
- Riabko, A., & Vakaliuk, T. A. (2024). Physics on autopilot: Exploring the use of an AI assistant for independent problem-solving practice. *Educational Technology Quarterly*, 2024(1), 56–75.
- Rudenko, S., Sapenko, R., Bazaluk, O., & Tytarenko, V. (2018). Management features of international educational projects between universities of Poland and Ukraine. *Naukovy Visnyk Natsionalnoho Hirnychoho Universytetu*, 2, 142–147.
- Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence (2023). Available at: <https://www.federalregister.gov/documents/2023/11/01/2023-24283/safe-secure-and-trustworthy-development-and-use-of-artificial-intelligence> (accessed 23 February 2026).
- Sain, Z. H., Sain, S. H., & Serban, R. (2024). Implementing artificial intelligence in educational management systems: A comprehensive study of opportunities and challenges. *Asian Journal of Managerial Science*, 13(1), 23–31.
- Schiff, D. S. (2020). Out of the laboratory and into the classroom: The future of artificial intelligence in education. *AI & Society*, 36(1), 331–348.
- Shaikh, Z. (2026). Integration of digital pedagogy and development of holistic learning ecosystem for students: The teachers' perspective. *International Journal of Educational Reform*, 35(1), 275–298.
- Shkodzinsky, O., & Lutskiv, M. (2022). Automated AI-based proctoring for online testing in e-learning system. *Scientific Journal of the Ternopil National Technical University*, 107(3), 76–85.
- The Times of Central Asia (2024). Harnessing AI for inclusive education: Transforming learning experiences in Kazakhstan. Available at: <https://timesca.com/harnessing-ai-for-inclusive-education-transforming-learning-experiences-in-kazakhstan/> (accessed 23 February 2026).
- UNESCO (2024). AI in education: Guidance for policy-makers. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000376709> (accessed 23 February 2026).
- UNICEF; NURIS (2024). Artificial intelligence in secondary education: UNICEF and NURIS launch joint education project. Available at: <https://www.unicef.org/kazakhstan/en/press-releases/artificial-intelligence-secondary-education-unicef-and-nuris-launch-joint-education> (accessed 23 February 2026).
- World Economic Forum (2024). Education 4.0 framework. Available at: <https://www.weforum.org/education-4-0-framework/> (accessed 23 February 2026).
- Wróblewski, Ł. (2025). Phygital consumption of cultural services: segmenting consumers by purchase channel preferences. *Cultural Management: Science and Education*, 9 (1), 31–48.
- Yang, S. J. H., Ogata, H., & Matsui, T. (2023). Guest editorial: Human-centered AI in education: Augment human intelligence with machine intelligence. *Journal of Educational Technology & Society*, 26(1), 95–98.
- Yim, I. H. Y., & Su, J. (2025). Artificial intelligence (AI) learning tools in K–12 education: A scoping

- review. *Journal of Computers in Education*, 12, 93–131.
- Zhang, K., & Aslan, A. (2021). AI technologies for education: Recent research & future directions. *Computers and Education: Artificial Intelligence*, 2, 100025.
- Zhang, Q., & Maclellan, C. J. (2022). (A)I will teach you to play Gomoku: Exploring the use of game AI to teach people. In: *Proceedings of the Ninth ACM Conference on Learning @ Scale (L@S '22)* (pp. 263–266). Association for Computing Machinery.
- Zhantassova, Z., Mukasheva, R., Rakhmetullina, Z., & Seitakhmetova, Z. (2020). Mathematical model of curriculum development taking into account individual preferences of students. In: *4th International Symposium on Multidisciplinary Studies and Innovative Technologies, ISMSIT 2020 – Proceedings* (p. 9254848). Institute of Electrical and Electronics Engineers.
- Zholdosheva, A. (2022). Trends of modern education and their influence on socialization of the student's personality. *Bulletin of the Jusup Balasagyn Kyrgyz National University*, 14(2), 92–100.