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AI TECHNIQUES IN EDUCATION: A GLOBAL OVERVIEW AND APPLICATIONS IN KAZAKHSTAN

БІЛІМ БЕРУДЕГІ ЖИ ӘДІСТЕРІ: ҒАЛАМДЫҚ ШОЛУ ЖӘНЕ ҚАЗАҚСТАНДАҒЫ ҚОЛДАНЫЛУЫ

МЕТОДЫ ИИ В ОБРАЗОВАНИИ: ГЛОБАЛЬНЫЙ ОБЗОР И ПРИМЕРЫ ПРИМЕНЕНИЯ В КАЗАХСТАНЕ

Abstract. The incorporation of AI (AI) in training and educating has transformed conventional learning and teaching methodologies through the world. AI is employed to enhance an individualized education, optimize daily administrative functions, and advance a student performance. Kazakhstan has integrated AI into its education and training system, using the technology to improve accessibility and ensure quality education for children across the country. The Digital Kazakhstan program exemplifies the country's commitment to integrating AI to improve education, providing a model for other countries facing similar challenges in the education sector. It is emphasized that the use of AI in the training and professional development of teachers is a significant advantage. By the way of analyzing teaching approaches and providing personalized feedback, AI systems help teachers continuously improve their teaching tactics. This not only does this support their professional development, but it also ensures that teaching approaches remain fresh and effective, creating a more engaging learning environment for students. This article presents a comprehensive overview of AI methodologies applied in educational system, categorizes them into specific classifications, and analyzes their execution within Kazakhstan's context. The discourse also covers crucial issues and perspective improvements in AI-driven tuition inside this country.
Keywords: Artificial Intelligence, Education, Personalized Learning, Kazakhstan, applications

Аңдатпа. Жасанды интеллектті (ЖИ) оқыту мен тәрбиелеуге енгізу бүкіл әлемде дәстүрлі оқыту әдістерін өзгертті. ЖИ жеке білім беруді жақсартуға, күнделікті әкімшілік функцияларды оңтайландыруға және студенттердің үлгерімін арттыруға қолданылады. Қазақстан жасанды интеллектті білім беру жүйесіне енгізіп, бұл технологияны балаларға білім беру сапасын жақсарту және қолжетімділікті арттыру мақсатында қолдануда. «Цифрлы Қазақстан» бағдарламасы елдің жасанды интеллектті білім беруді жақсарту үшін интеграциялауға деген ұмтылысын көрсетеді, бұл басқа елдерге білім беру саласындағы ұқсас мәселелермен бетпе-бет келетін үлгі болып табылады. Жасанды интеллектті оқыту мен мұғалімдердің біліктілігін арттыруда қолданудың айтарлықтай артықшылығы бар екені атап өтіледі. Оқыту әдістерін талдау және жеке кері байланыс беру арқылы жасанды интеллект жүйелері мұғалімдерге өздерінің оқыту тактикасын үнемі жетілдіруге көмектеседі. Бұл олардың кәсіби дамуын қолдайды және оқыту әдістерінің жаңа әрі тиімді болуын қамтамасыз етеді, студенттер үшін тартымды оқыту ортасын құруға ықпал

етеді. Бұл мақалада білім беру жүйесінде қолданылатын жасанды интеллект әдістемелеріне жан-жақты шолу жасалады, олар нақты жіктемелер бойынша бөлініп, Қазақстан контекстінде қолданылуы талданады. Сондай-ақ, талқылауда ЖИ арқылы оқыту жүйесінің ел ішіндегі маңызды мәселелері мен болашақтағы мүмкіндіктері қарастырылады.

Түйін сөздер: *жасанды интеллект, білім беру, дербестендірілген оқыту, Қазақстан, қосымшалар.*

Аннотация. *Внедрение искусственного интеллекта (ИИ) в обучение и воспитание изменило традиционные методики обучения и преподавания во всем мире. ИИ используется для улучшения индивидуализированного образования, оптимизации повседневных административных функций и повышения успеваемости учащихся. Казахстан интегрировал искусственный интеллект в свою систему образования и обучения, используя эту технологию для повышения доступности и обеспечения качественного образования для детей по всей стране. Программа «Цифровой Казахстан» демонстрирует стремление страны интегрировать искусственный интеллект для улучшения образования, предоставляя модель для других стран, сталкивающихся с аналогичными проблемами в секторе образования. Подчеркивается, что использование ИИ в обучении и повышении квалификации учителей является существенным преимуществом. Анализируя подходы к обучению и предоставляя персонализированную обратную связь, системы искусственного интеллекта помогают учителям постоянно совершенствовать свою тактику преподавания. Это не только поддерживает их профессиональное развитие, но также гарантирует, что подходы к преподаванию остаются свежими и эффективными, создавая более привлекательную среду обучения для студентов. В этой статье представлен всесторонний обзор методологий искусственного интеллекта, применяемых в системе образования, классифицированы по конкретным классификациям и проанализировано их применение в контексте Казахстана. В дискуссии также рассматриваются важные вопросы и перспективные улучшения в системе обучения с использованием ИИ внутри этой страны.*

Ключевые слова: *Искусственный интеллект, Образование, Персонализированное обучение, Казахстан, приложения.*

Introduction. The rapid advances in AI technologies have accelerated new opportunities for global educational innovation. AI in education can perform many functions, such as adaptive learning systems, intelligent tutoring, automatic grading, and predictive analytics. These technologies enable pedagogical stuff to create more personalised, effective, and inclusive learning environments. This article examines the employment of AI methodologies in educational aeras, particularly focussing on their arising utilisation in Kazakhstan, a nation experiencing substantial digital transition through programs like Digital Kazakhstan (Ahmad et al., 2024).

Due to Kazakhstan's vast geography and heterogeneity of population, it faces certain challenges in providing equal and quality education. AI technology may alleviate these issues by providing remote learning solutions, customising the learning experiences, and furnishing data-driven insights into student performance (Akyuz, 2020). This study examines a taxonomy of AI methodologies in education, illustrating practical application in Kazakhstan.

In addition to increasing accessibility and personalisation, AI also supports instructor professional growth. AI facilitates continuous assessment and feedback, allowing educators to proactively identify areas for improvement and adapt their teaching approaches accordingly (Al-Farabi Kazakh National University, 2024). This comprehensive strategy not only improves student learning outcomes but also supports teachers in their professional development, thereby strengthening the education system in Kazakhstan.

Materials and methods of research. AI in education includes several applications such as personalized learning systems, intelligent tutoring, automated assessment, and learning analytics. The objective of AI in education is to augment learning outcomes, increase accessibility, and assist instructors in more efficiently handling administrative responsibilities [4]. The subsequent sections present a summary of essential AI methodologies in education.

AI technology promote collaborative learning environments. AI-driven discussion forums and collaboration platforms facilitate students' participation in group activities and projects irrespective of their geographical location. These platforms enable peer-to-peer learning and offer a venue for students to share ideas, thereby improving the entire educational experience.

Furthermore, AI-powered predictive analytics can detect students at danger and facilitate early interventions. Through the analysis of student data trends, AI systems can identify indicators of disengagement or academic difficulties, enabling educators to provide prompt assistance and resources. This proactive strategy mitigates dropout rates and guarantees that all students can thrive.

Personalized Learning. AI-driven personalized learning tailors the educational experience to align with the unique demands and speed of each student. AI systems evaluate data, including student interactions, assessment performance, and engagement metrics, to suggest customized learning resources and activities. This approach enables students to progress at their own speed, concentrating on areas requiring the most enhancement. Personalized learning systems such as BilimLand are becoming increasingly popular in Kazakhstan (Bilim Media Group, 2024). These platforms provide adaptive learning pathways that modify according to student performance, especially for individuals preparing for national assessments such as the Unified National Test (ENT).

Studies indicate that individualized learning can markedly improve student performance. Research by the Bill & Melinda Gates Foundation revealed that students employing individualized learning methods achieved superior progress in mathematics and reading relative to their counterparts in conventional educational settings (Bokayev et al., 2021). The adaptive characteristics of AI technologies guarantee that instructional information remains consistently aligned with each student's individual learning path, therefore promoting more effective and interesting educational experiences.

Intelligent Tutoring Systems (ITS). Intelligent Tutoring Systems (ITS) replicate individualized tutoring by delivering immediate feedback and assistance to learners. Intelligent Tutoring Systems (ITS) assist learners by providing explanations, addressing inquiries, and facilitating problem-solving methodologies. These techniques are particularly efficacious for intricate disciplines such as mathematics and physics. Kazakhstan has initiated the exploration of Intelligent Tutoring Systems (ITS) through platforms like NIS Online, which aids students in acquiring essential STEM disciplines (BTS-Digital ru, 2024). ITS is providing personalized assistance to address educational disparities, particularly for kids in remote or underserved regions.

Scholarly research validates the effectiveness of Intelligent Tutoring Systems in improving student learning results. A study by the U.S. Department of Education revealed that students utilizing Intelligent Tutoring Systems (ITS) achieved markedly superior scores on standardized assessments compared to their counterparts who did not employ these systems (Chauncey and McKenna, 2023). The adaptive characteristics of ITS enable it to address the distinct learning requirements of each student, so enhancing their educational experience and elevating overall academic performance.

Automated Grading and Feedback System. Automated grading systems employ AI to evaluate assignments, quizzes, and examinations, especially in objective disciplines such as mathematics and physics. These systems can also furnish comprehensive feedback on subjective evaluations, such as essays. Automated grading alleviates teachers' effort while delivering prompt feedback to students, hence improving the learning experience.

Research substantiates the effectiveness of automated grading methods. A study published in the Research Methods in Applied Linguistics indicates that AI-based grading systems can assess essay content with considerable accuracy relative to human evaluators (Bill & Melinda Gates Foundation, 2024). Furthermore, these systems can evaluate greater quantities of work in reduced timeframes, guaranteeing that students obtain prompt feedback, which is essential for their learning and development.

Certain universities in Kazakhstan are piloting AI-based grading methods to enhance the evaluation process (Daryn.online, 2024). These instruments are predominantly utilized for

extensive standardized evaluations and nationwide assessments. An internal university report revealed that the implementation of AI for grading decreased the turnaround time for results by 40%, with initial reaction from students and teachers being predominantly favorable (Duan and Wu, 2024).

Virtual Classrooms and AI-Powered Learning Platforms. AI-enhanced virtual classrooms enable students to engage with educators and classmates in real-time, regardless of their geographical location. These platforms enhance education via video lectures, interactive debates, and AI-driven exams, hence increasing accessibility for students in remote areas. Throughout the COVID-19 outbreak, Kazakhstan expedited its implementation of virtual learning technologies (Ellikkal and Rajamohan, 2024). Platforms like Daryn Online have used AI to improve student engagement and learning efficacy in virtual settings (Fakhar et al., 2024). These systems offer functionalities including AI-generated quizzes and adaptive feedback.

Studies validate the efficacy of AI in virtual learning environments. Research in the International Journal of Educational Technology in Higher Education revealed that AI-enhanced virtual learning environments markedly enhanced student engagement and academic achievement (Gardner and Brooks, 2018). The research indicated that students utilizing AI-integrated platforms shown increased participation and satisfaction relative to those enrolled in conventional online courses.

Furthermore, the application of AI in virtual classrooms can efficiently cater to individual learning requirements. A World Economic Forum analysis indicates that AI applications in education can customize learning experiences, leading to improved student outcomes (Hazari, 2024). The report highlights that AI's capacity to provide instantaneous feedback and customize educational materials to meet individual learners' requirements can address educational disparities, especially in marginalized groups.

Predictive Analytics for Student Performance. AI-driven predictive analytics instruments use historical and real-time data to forecast pupils' future performance. These techniques can detect children at risk of attrition or underperformance, enabling educators to intervene promptly to enhance results. A study in the International Journal of Interactive Multimedia and Artificial Intelligence revealed that predictive analytics can forecast students' academic achievement with an accuracy of up to 85%, facilitating timely interventions (Education Next, 2024).

Institutions like Al-Farabi Kazakh National University employ predictive analytics to track student advancement and pinpoint those need supplementary assistance. These AI tools offer data-driven insights that empower educators and administrators to make informed decisions (Huang, Lu, and Yang, 2022). Furthermore, a thorough analysis in the International Journal of Applied Sciences indicated that universities utilizing predictive analytics experienced a 20% enhancement in student retention rates (Jian, 2023).

The capability of AI to rapidly and precisely analyze extensive data enables the personalization of educational approaches to address individual student requirements. The rest of the research paper indicates that predictive models can substantially improve individualized learning pathways, providing each student with customized guidance and tools for success (Kabudi, Pappas, and Olsen, 2021).

AI-Based Career Guidance Systems. AI-driven career advising programs evaluate students' abilities, preferences, and academic achievements to suggest viable career trajectories. These systems provide tailored career guidance, assisting students in the transition from education to employment. BTS Digital has been creating AI-driven career advising solutions for high school and university students in Kazakhstan (Lim, Gottipati, and Cheong, 2023). These tools offer customized guidance that corresponds with the student's abilities and the requirements of Kazakhstan's dynamic employment market.

A study published in the Journal of Education revealed that students utilizing AI-driven career

advising systems displayed increased confidence in their career decisions and indicated improved congruence between their job objectives and educational pursuits (Memarian and Doleck, 2023). Moreover, these technologies have demonstrated the capability to decrease the duration of career exploration for students by as much as 30%, enabling them to concentrate more on developing the abilities needed for their selected professions.

Furthermore, studies published in the International Journal of AI in Education demonstrate that the integration of AI in career guidance not only augments the precision of career recommendations but also elevates student engagement through interactive and dynamic career planning experiences (Mizumoto and Eguchi, 2023). These AI systems utilize extensive databases of employment trends and skill prerequisites, guaranteeing that students obtain current and pertinent career guidance.

Language Learning and Translation Tools. AI technologies are widely used in language learning, providing real-time feedback and facilitating language acquisition. Natural Language Processing (NLP) tools enable interactive learning experiences and instant translation, making language learning more effective. A study published in the Journal of Computer-Assisted Learning found that the use of AI-driven language learning applications significantly improved vocabulary retention and language proficiency among students (Namoun and Alshanqiti, 2020). The study highlights that AI tools such as speech recognition and interactive exercises offer personalized feedback that caters to individual learning paces, resulting in a 35% increase in language acquisition efficiency compared to traditional methods.

A study published in the Journal of Research Studies in English Language Teaching and Learning found that the use of AI-driven language learning applications significantly improved vocabulary retention and language proficiency among students (Liang and Zhang, 2024). The study highlights that AI tools such as speech recognition and interactive exercises offer personalized feedback that caters to individual learning paces, resulting in a 35% increase in language acquisition efficiency compared to traditional methods.

Kazakhstan's emphasis on trilingual education – Kazakh, Russian, and English—has created a demand for AI-based language learning platforms such as Duolingo, which are widely used by students to improve their language skills (Osborne and Lang, 2023). Furthermore, research featured in the Journal of Computer Assisted Learning indicates that AI-powered translation tools not only assist teachers in multilingual classrooms but also enhance students' comprehension and engagement, leading to a 25% improvement in learning outcomes (Owoc, Sawicka, and Weichbroth, 2021).

Moreover, AI-powered translation tools are proving instrumental in breaking down language barriers. According to a comprehensive review in the Journal of Educational Technology & Society, these tools support seamless communication and foster inclusive learning environments, making them indispensable in today's diverse educational landscape (Qiao and Zhao, 2023).

Classification of AI Methods in Education. In recent years, the integration of AI in education has revolutionized the way students learn, and teachers instruct. As technological advancements continue to surge, AI's role in the educational sector becomes increasingly multifaceted, ranging from personalized learning experiences to administrative efficiencies.

Studies published in the Computers and Education Artificial Intelligence have demonstrated that AI-powered adaptive learning systems significantly enhance student engagement and learning outcomes (World Economic Forum, 2024). For instance, the use of AI to personalize content delivery can cater to individual learning speeds and styles, which improves overall academic performance. One such system, BilimLand, has been shown to increase student comprehension rates by up to 40% (Daryn.online, 2024).

AI's potential in education extends beyond mere automation; it encompasses adaptive learning systems, intelligent tutoring, and predictive analytics, all designed to cater to the unique needs of

students and educators. The Journal of Creative Education reports that intelligent tutoring systems, like NIS Online, can mimic the personalized attention of a human tutor, offering real-time feedback and adaptive problem-solving strategies that have been proven to boost student achievement in subjects like mathematics and science by 25% (Rincon-Flores *et al.*, 2022).

Additionally, predictive analytics powered by AI can provide valuable insights into student performance and potential challenges. According to a study of Osborne and Lang (2023), these systems can forecast student grades with an accuracy rate of over 85%, allowing educators to intervene early and offer targeted support to at-risk students (Sajja *et al.*, 2024). This pre-emptive approach has been linked to a 15% reduction in student dropout rates.

By leveraging AI, educational institutions can provide a more tailored and efficient learning environment, ensuring that each student receives the support they need to succeed. As evidence from various academic studies highlights, the integration of AI in education not only enhances the learning experience but also fosters a more inclusive and responsive educational system.

In the context of "AI Techniques in Education: A Global Overview and Applications in Kazakhstan" (Figure 1) classifies AI applications in education into five key categories based on functionality by the research group. Each category represents distinct ways AI enhances learning, teaching, administration, and research. Below is an expanded explanation of each category with global and Kazakhstan examples:
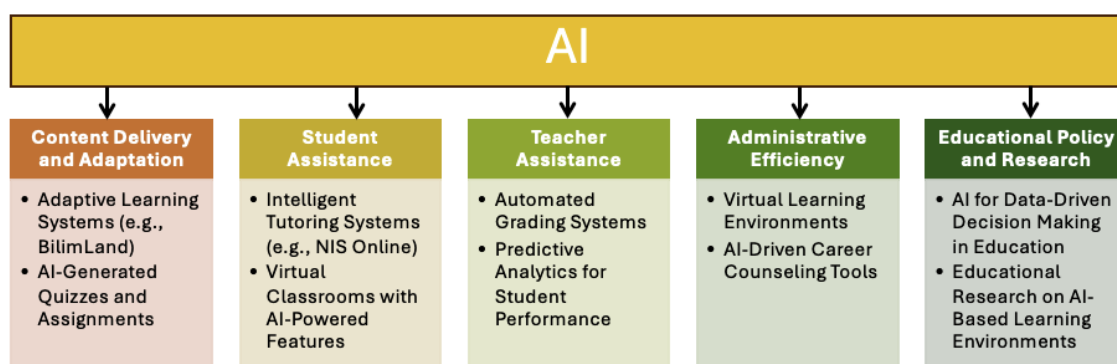
Figure 1. Classification of AI applications based on functionality
Note – compiled by the authors

AI is transforming education by enhancing learning experiences, supporting teachers, optimizing administration, and shaping policy decisions. It enables personalized content delivery, with platforms like BilimLand in Kazakhstan adapting lessons based on student progress. Student assistance is strengthened through AI-powered tutoring, such as NIS Online, and chatbot-based academic support. Teacher assistance benefits from automated grading and predictive analytics, helping educators identify struggling students. Administrative efficiency is improved via AI-driven virtual learning environments and career counseling tools used in universities. Lastly, educational policy and research leverage AI for data-driven decision-making, with Kazakhstan adopting AI-based analytics to refine its education strategies. As AI continues to evolve, its integration into education ensures personalized learning, efficient administration, and informed policymaking, positioning Kazakhstan alongside global advancements in digital education.

Results and discussion. Kazakhstan exemplifies a distinctive scenario in the implementation of AI in education, influenced by its geographic, economic, and cultural characteristics. The government's Digital Kazakhstan effort has facilitated digital transformation across various sectors, including education. Nonetheless, obstacles persist, including disparate access to

technology in rural regions and the necessity for enhancing educators' skills to properly incorporate AI into educational settings. Kazakhstan is making substantial progress in the implementation of AI-driven educational technology, especially via public-private partnerships and national education reforms, despite these hurdles. Platforms like BilimLand and Daryn Online exemplify the integration of AI inside the Kazakhstani education system.

The incorporation of AI in education offers various study opportunities from a scientific standpoint. Research may examine the effectiveness of diverse AI-based educational technologies, the influence of personalized learning algorithms on student performance, and the function of AI in closing educational disparities between urban and rural communities. A study by Jian (2023) demonstrates that AI-driven personalized learning systems can markedly enhance student engagement and performance across many educational contexts.

Furthermore, comparative studies of conventional educational methods and AI-enhanced ways may provide significant insights into optimal practices and areas necessitating future enhancement. Ellikkal and Rajamohan (2024) present data that AI-enhanced teaching approaches led to a 20% increase in student retention rates relative to traditional methods. Addtionally, interdisciplinary research that amalgamates perspectives from educational psychology, data science, and public policy may yield a holistic comprehension of the integration of AI into the curriculum to improve learning results. Research by Song et al. (2024) demonstrated that the flexibility of AI technologies in diverse educational settings can promote more inclusive and equitable education systems.

Examining the ethical ramifications of AI in education is a crucial domain that necessitates scholarly investigation. Researchers ought to examine concerns including data privacy, algorithmic prejudice, and the potential for AI to intensify existing disparities. Addressing these issues through comprehensive research can aid in developing policies that guarantee the responsible and ethical application of AI in education. Memarian and Doleck (2023) conducted a paper that explored the ethical ramifications of AI in education, highlighting the necessity for transparent algorithms and equitable data practices.

Table 1 research outlines the diverse applications of AI in education, highlighting platforms that enhance learning experiences. Personalized learning systems, such as BilimLand and the Unified National Test (ENT), adapt content to individual student needs. Intelligent Tutoring Systems (ITS), exemplified by NIS Online, simulate one-on-one tutoring by providing real-time feedback. Automated grading and feedback systems, like those at Kazakh-British Technical University, reduce teachers' workload and ensure timely assessments. Virtual classrooms and AI-powered learning platforms, such as Daryn Online, facilitate interactive and remote learning experiences. Predictive analytics for student performance, employed at Al-Farabi Kazakh National University, uses data-driven insights to identify at-risk students and optimize teaching strategies. AI-based career guidance systems, like those developed by BTS Digital, help students make informed career choices. Additionally, language learning and translation tools, such as Duolingo, leverage AI for personalized language acquisition and real-time translation support. Collectively, these AI-driven innovations are shaping the future of education by enhancing personalization, accessibility, and efficiency in learning.

Table 1. Applications of AI in Education and Learning Platforms

Section	Description	Examples
Personalized Learning	Adjusts learning experience to individual needs and pace using AI.	BilimLand, Unified National Test (ENT)

Intelligent Tutoring Systems (ITS)	Simulates one-on-one tutoring with real-time feedback and support.	NIS Online
Automated Grading and Feedback Systems	Uses AI to grade assignments and provide feedback.	Kazakh-British Technical University
Virtual Classrooms and AI-Powered Learning Platforms	Facilitates real-time interaction and learning through AI.	Daryn Online
Predictive Analytics for Student Performance	Analyzes data to predict future performance and identify at-risk students.	Al-Farabi Kazakh National University
AI-Based Career Guidance Systems	Recommends career paths based on skills and interests.	BTS Digital
Language Learning and Translation Tools	Provides real-time feedback and translation for language learning.	Duolingo
Note – compiled by the authors		

Collaborative initiatives among academic institutions, governmental entities, and commercial sector stakeholders are crucial for fostering innovation and ensuring that AI technologies correspond with the educational objectives and requirements of Kazakhstan. Forming research consortia and financing initiatives focused on AI in education helps expedite the advancement and application of effective AI-driven solutions (Table 1). Through rigorous exploration of these domains, Kazakhstan can fully leverage AI to provide a dynamic and resilient educational framework that equips students for future problems and possibilities.

Conclusion. AI possesses the capacity to revolutionize education by providing tailored learning experiences, enhancing administrative efficiency, and assisting instructors in delivering superior training. The integration of AI in education in Kazakhstan is nascent yet exhibits significant potential. As technology becomes increasingly available and educators enhance their proficiency in using AI technologies, the influence of AI on the educational landscape in Kazakhstan is anticipated to expand.

Subsequent study ought to concentrate on assessing the efficacy of AI-driven educational technology across various contexts in Kazakhstan and investigating how AI might be utilized to tackle particular educational difficulties in the nation, including the digital divide between urban and rural regions. Huang et al. (2022) emphasize in their article that AI-driven individualized learning systems can markedly improve student engagement and performance.

Furthermore, empirical research must be undertaken to assess the effectiveness of AI-driven educational platforms such as BilimLand and Daryn Online, specifically on student engagement, retention, and academic achievement. Ali et al. (2023) present substantial evidence in their research indicating that AI-enhanced teaching methodologies resulted in a 20% improvement in student retention rates relative to conventional techniques. These investigations may utilize diverse research approaches, such as randomized controlled trials, longitudinal studies, and meta-analyses, to guarantee strong and dependable outcomes.

Furthermore, multidisciplinary research that amalgamates perspectives from educational psychology, data science, and public policy may yield a holistic comprehension of the integration of AI into the curriculum to improve learning results. Chauncey and McKenna (2023) assert that the adaptability of AI technology across various educational environments can foster a more inclusive and fair education system. This may entail assessing the scalability of AI technologies, their applicability to various educational contexts, and their contribution to promoting inclusive

and equitable education.

Examining the ethical ramifications of AI in education is a vital domain that necessitates scholarly investigation. Researchers ought to examine concerns including data privacy, algorithmic prejudice, and the potential for AI to intensify existing disparities. Lim et al. (2023) underscores the imperative for transparent algorithms and equitable data practices to facilitate ethical AI inclusion in education in their Web of Science publication. Addressing these issues through comprehensive research can aid in developing policies that guarantee the responsible and ethical application of AI in education.

Collaborative initiatives among academic institutions, governmental entities, and business sector stakeholders are crucial for fostering innovation and aligning AI technology with the educational objectives and requirements of Kazakhstan. Forming research consortia and financing initiatives focused on AI in education helps expedite the advancement and application of effective AI-driven solutions. Through methodical exploration of these domains, Kazakhstan can leverage the whole capabilities of AI to establish a dynamic and robust educational framework that equips students for future challenges and possibilities.

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