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PEDAGOGICAL AND DIGITAL ASPECTS OF THE USE OF GENERATIVE AI TECHNOLOGIES IN KAZAKH LANGUAGE EDUCATION

Abstract

The article presents a comprehensive analysis of the effectiveness of the use of generative artificial intelligence (AI) technologies in language education using the example of learning the Kazakh language. In an environment where the dominance of English in AI development creates risks of digital exclusion for many languages of the world, Kazakhstan demonstrates a strategic approach to creating a sovereign national AI ecosystem.

The research covers all levels of this ecosystem: from fundamental developments, such as the Large Language Model (LLM) Kaz-LLM, to applied learning tools and platforms (for example, Janymda, Qonzhyq App, Talkio AI). The paper systematizes the pedagogical principles of using generative AI in language teaching, including personalization, interactivity, and feedback automation. Based on these principles, a critical assessment of the functionality and pedagogical potential of existing Kazakhstani applications is carried out.

The key findings of the study show that Kazakhstan has developed a unique AI infrastructure, supported at the state and corporate levels, which is a response to the global challenge for low-resource languages. Existing applications successfully implement basic didactic functions, increasing students' motivation and engagement. However, there is a gap between the technological potential of the fundamental models and the current implementation in applied solutions, especially in the field of deep adaptive personalization and the transfer of cultural nuances. In conclusion, it is emphasized that the purposeful development and pedagogically competent implementation of these technologies opens up transformational opportunities for the preservation, popularization and enhancement of the status of the Kazakh language in the global digital space.

Keywords: generative AI, Kazakh language teaching, large language models, intelligent tutor systems, digital pedagogy.

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ГЕНЕРАТИВТІ ЖИ ТЕХНОЛОГИЯЛАРЫН ҚАЗАҚ ТІЛІ БІЛІМІНДЕ ҚОЛДАНУДЫҢ ПЕДАГОГИКАЛЫҚ ЖӘНЕ ЦИФРЛЫҚ ҚЫРЛАРЫ

Аңдатпа

Мақалада қазақ тілін оқыту мысалында тілдік білім беруде жасанды интеллект (ЖИ) генеративті технологияларын қолданудың тиімділігіне кешенді талдау ұсынылған. ЖИ-ді әзірлеуде ағылшын тілінің үстемдігі әлемнің көптеген тілдері үшін цифрлық шеттету қаупін туғызған жағдайда, Қазақстан егеменді ұлттық ЖИ-экожүйесін құруға стратегиялық көзқарасын көрсетеді.

Зерттеу осы экожүйенің барлық деңгейлерін қамтиды: Kaz-LLM үлкен тіл моделі (LLM) сияқты іргелі әзірлемелерден бастап, қолданбалы оқыту құралдары мен платформаларына дейін (мысалы, Janymda, Qonzhyq App, Talkio AI). Жұмыста жекелендіру, интерактивтілік және автоматтандырылған кері байланысты қоса алғанда, тілдерді оқытуда генеративті ЖИ-ді қолданудың педагогикалық қағидаттары жүйеленген. Осы қағидаттар негізінде қолданыстағы қазақстандық қосымшалардың функционалдығы мен педагогикалық әлеуетіне сыни баға берілген.

Зерттеудің негізгі қорытындылары Қазақстанда ресурстары аз тілдерге арналған жаһандық сын-қатерге жауап беретін, мемлекеттік және корпоративтік деңгейде қолдау табатын бірегей ЖИ инфрақұрылымы қалыптасқанын көрсетеді. Қолданыстағы қосымшалар оқушылардың ынтасы мен белсенділігін арттыра отырып, негізгі дидактикалық функцияларды сәтті жүзеге асырады. Алайда, іргелі модельдердің технологиялық әлеуеті мен қолданбалы шешімдердегі қазіргі жүзеге асырылуы арасында, әсіресе терең бейімделгіш жекелендіру және мәдени ерекшеліктерді жеткізу саласында алшақтық бар. Қорытындылай келе, бұл технологияларды мақсатты дамыту және педагогикалық тұрғыда сауатты енгізу жаһандық цифрлық кеңістікте қазақ тілінің мәртебесін сақтау, насихаттау және арттыру үшін ауқымды мүмкіндіктер ашатыны атап өтілді.

Түйін сөздер: жасанды интеллект, генеративті ЖИ, қазақ тілін оқыту, үлкен тілдік модельдер, зияткерлік тьюторлық жүйелер.

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ПЕДАГОГИЧЕСКИЕ И ЦИФРОВЫЕ АСПЕКТЫ ПРИМЕНЕНИЯ ГЕНЕРАТИВНЫХ ИИ ТЕХНОЛОГИЙ В ОБРАЗОВАНИИ КАЗАХСКОГО ЯЗЫКА

Аннотация

В статье представлен комплексный анализ эффективности применения генеративных технологий искусственного интеллекта (ИИ) в языковом образовании на примере изучения казахского языка. В условиях, когда доминирование английского языка в разработке ИИ создаёт риски цифрового исключения для многих языков мира, Казахстан демонстрирует стратегический подход к созданию суверенной национальной ИИ-экосистемы.

Исследование охватывает все уровни этой экосистемы: от фундаментальных разработок, таких как большая языковая модель (LLM) Kaz-LLM, до прикладных обучающих инструментов и платформ (например, Janymda, Qonzhyq App, Talkio AI). В работе систематизируются педагогические принципы использования генеративного ИИ в обучении языкам, включая персонализацию, интерактивность и автоматизацию обратной связи. На основе этих принципов проводится критическая оценка функционала и педагогического потенциала существующих казахстанских приложений.

Ключевые выводы исследования показывают, что в Казахстане сформирована уникальная, поддерживаемая на государственном и корпоративном уровне ИИ-инфраструктура, являющаяся ответом на глобальный вызов для низкоресурсных языков. Существующие приложения успешно реализуют базовые дидактические функции, повышая мотивацию и вовлечённость учащихся. Однако отмечается разрыв между технологическим потенциалом фундаментальных моделей и текущей реализацией в прикладных решениях, особенно в области глубокой адаптивной персонализации и передачи культурных нюансов. В заключение подчёркивается, что целенаправленное развитие и педагогически грамотное внедрение этих технологий открывает трансформационные возможности для сохранения, популяризации и повышения статуса казахского языка в глобальном цифровом пространстве.

Ключевые слова: искусственный интеллект, генеративный ИИ, обучение казахскому языку, большие языковые модели, интеллектуальные тьюторские системы.

Introduction. The rapid development of generative artificial intelligence (AI) technologies, especially large language models (LLM), exacerbates the problem of digital inequality. The dominance of English in AI learning threatens the digital exclusion of low-resource languages, limiting their native speakers' access to educational, cultural, and scientific processes and undermining linguistic diversity.

In response to these challenges, Kazakhstan is forming a sovereign AI ecosystem adapted to the needs of the Kazakh language. The key achievement was the creation of the Kaz-LLM national language model, trained on the Kazakh corpus of texts, and the launch of applied educational platforms (Janymda, Qonzhyq App, Talkio AI, etc.). This is supported by legislative initiatives, such as amendments to the Law «On Culture» to officially define the concepts of the «Big language model of the Kazakh language» and the «National Dictionary Fund», as well as the formation of powerful consortia uniting the efforts of academia, government agencies and private business, which orients Kazakhstan towards the development of its own tools integrated into national cultural and linguistic context [1].

The present study is aimed at a pedagogical assessment of the effectiveness of generative AI technologies in teaching the Kazakh language. The analytical framework is based on the principles of personalization, interactivity, and feedback automation.

Basic provisions. In a modern society characterized by accelerated technological progress and globalization, there is an increasing need for new approaches to education, including in the field of language training. Our research assumes that the successful application of generative artificial intelligence (AI) in teaching the Kazakh language should be based on a combination of digital capabilities and fundamental pedagogical principles.

We argue that the creation of a national AI ecosystem adapted to the needs of the Kazakh language is a strategic response to the challenges of digital inequality caused by the dominance of the English language in AI development. A key element of this ecosystem is the Kaz-LLM national language model, on the basis of which applied educational platforms such as Janymda, Qonzhyq App, Talkio AI and others are being developed.

At the same time, the analysis shows that there is a gap between the technological potential of fundamental models and their current implementation in applied solutions, especially in the field of adaptive personalization and transmission of cultural nuances. The full range of AI's capabilities, particularly in the field of deep adaptation, has yet to be revealed. This, in turn, highlights the indispensable role of the teacher, whose task is transformed into developing students' critical thinking and intercultural communication skills.

Thus, our research is aimed at a comprehensive analysis of the effectiveness of the use of generative AI in language education. It systematizes the pedagogical principles of its use and conducts a critical assessment of the functionality of existing Kazakhstani applications. The purposeful and pedagogically competent implementation of these technologies opens up transformational opportunities for the preservation, popularization and enhancement of the status of the Kazakh language in the global digital space.

Materials and Methods. The scientific novelty of the work consists in a comprehensive analysis of the compliance of existing AI tools with pedagogical tasks and linguistic features of the Kazakh language. The research not only systematizes current developments, but also reveals the gap between the technological potential of fundamental models and their practical implementation in the educational environment.

This paper considers the Kazakh experience as a significant example of the implementation of the concept of digital linguistic equality and examines the transformational potential of AI in teaching low-resource languages.

Generative artificial intelligence (AI) technologies, especially large language models (LLM), are showing rapid development [2;3;4], transforming approaches to education and, as Badshah et al. (2024) notes, going beyond automation. Systems like ChatGPT, Duolingo Max, and ELSA Speak simulate dialogue, act as assistants, mentors, and critics, analyzing errors and tracking progress (Zhai et al., 2023; Liu & Lu, 2024). However, as Floridi (2023) notes, AI is still limited in aspects of intercultural communication, emotional intelligence, and deep language pragmatics that require human understanding [5].

The problem of low-resource languages remains relevant [6]. UNESCO reports and the work of Joshi et al. (2020) highlight the scarcity of digital corpora and resources for most of the world's languages, which deepens digital inequality. In response, initiatives like Masakhane (for African languages) and Hugging Face BLOOM are developing, which includes training in 46 languages [7]. Special attention is paid to the development of national language models, for example, Kaz-LLM and Qazaq AI for the Kazakh language, aimed at expanding digital opportunities for native speakers of these languages.

At the same time, there is a growing interest in the pedagogical aspects of AI implementation. Research (Selwyn, 2023; Warschauer, 2024) highlights the need for new methodological approaches where humans and AI act as partners. Selwyn (2023) offers «AI-augmented pedagogy», where AI does not replace the teacher, but expands his capabilities, contributing to the integration of technology into educational goals and learning culture [8;9].

The research is aimed at a comprehensive analysis of the possibilities of using generative artificial intelligence technologies in teaching the Kazakh language. It was conducted in three interrelated stages: theoretical-analytical, descriptive-analytical and synthesizing.

At the first, theoretical and analytical stage, a content analysis of domestic and foreign scientific literature was conducted, covering digital pedagogy, methods of teaching languages with AI, the problems of low-resource languages and the development of large language models (LLM) [10]. Special attention was paid to publications of the last five years from the Scopus and Web of Science databases, as well as official regulatory documents of the Republic of Kazakhstan on the development of AI and language policy. The result of the stage was the substantiation of pedagogical criteria for assessing the educational potential of AI products: personalization, interactivity and automation of feedback.

At the second, descriptive and analytical stage, the methods of descriptive analytics, documentary and content analysis of digital resources were applied. Both fundamental language models (Kaz-LLM, YandexGPT, ChatGPT) and application platforms for teaching the Kazakh language (Janymda, Qonzhyq App, Talkio AI, Glossika, LangBuddy, etc.) were analyzed. The sources were the official websites of developers, technical documentation, press releases, descriptions of user functionality, as well as publications in open media and IT publications. The sample was formed according to the following criteria:

- Availability of functionality that supports the Kazakh language.
- Targeted focus on language learning (formal/informal).
- Open or conditionally open availability (applications, APIs, demo versions).
- Institutional affiliation to the Kazakh digital ecosystem or active involvement in it [11].

This approach provided a comprehensive view of the current state of the digital language environment, including domestic and international solutions adapted for the Kazakh language.

At the final, synthesizing stage, methods of comparative analysis, qualitative synthesis and an interpretive approach were used. The data obtained were compared with previously identified pedagogical criteria, which made it possible to identify the strengths and weaknesses of digital solutions and determine their compliance with modern language education requirements. A comparative analysis of Kazakhstani initiatives with international practices of using generative AI in language teaching (Duolingo Max, ELSA Speak, Speak AI, DeepL, etc.) was also conducted [12]. This integrated the research into a global scientific context and allowed us to assess the strategic importance of national developments in the context of digital inequality and the threat of digital exclusion of low-resource languages.

Results and Discussion. Kazakhstan's AI ecosystem for the state language is a multi-level structure that includes both fundamental technological developments and a wide range of application solutions for end users.

Any applied AI system is based on a fundamental model. Tremendous work has been done in Kazakhstan to create its own large language models, which is a key element of the national technology strategy.

National flagship: ISSAI KAZ-LLM

The central element of the ecosystem is the Kaz-LLM model, developed by a consortium led by the Institute of Intelligent Systems and Artificial Intelligence (ISSAI) at Nazarbayev University. This project is a prime example of a strategic public-private-academic partnership, which includes the Ministry of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan, IT company QazCode (a subsidiary of VEON), Beeline Kazakhstan and technopark Astana Hub [13]. Financial support was provided by NU and NIS funds, Astana Hub and QazCode, and at the initial stage the project was developed without direct participation of funds from the state budget.

Kaz-LLM is based on the modern Llama architecture and is presented in several scalable versions adapted to the Kazakh language. To train the model, a huge amount of data was collected and processed, more than 150 billion tokens, and 95% of this volume was prepared directly by the ISSAI team, dubbed the «Token Factory». The data was extracted from publicly available sources, including Kazakhstani websites, news portals, and online libraries [14].

Other key generative models

In addition to Kaz-LLM, there are other models on the market adapted for the Kazakh language. YandexGPT became the first large public generative neural network that was specially trained to understand and generate speech in the Kazakh language [15]. OpenAI's global ChatGPT model, although not specifically designed for Kazakh, has become a de facto popular tool among language learners due to its powerful capabilities and wide availability through official app stores.

Legislative and institutional framework

The uniqueness of the Kazakh approach lies in the creation of a solid legal framework. Amendments to the Law of the Republic of Kazakhstan «On Culture» have officially consolidated the concepts of the «Large Linguistic Model of the Kazakh language» and the «National Dictionary Fund of the Kazakh

Language» in the legislation [16]. The latter is defined as a publicly available government information system that serves as a data source for the design and development of LLM. This creates an unprecedented synergy between cultural policy and technological development in many countries.

A comparative analysis of three key language models used or with potential for application in Kazakh language education: ISSAI KAZ-LLM, YandexGPT and ChatGPT according to a number of important parameters such as developer, technical features, data focus, accessibility and strategic goals is shown in Table 1.

Table 1. Comparative characteristics of key language models for the Kazakh language

Model name	Developer/ The Consortium	Key Technical Feature	The focus of training data for the Kazakh language	Availability	A strategic goal for the Kazakh language
ISSAI KAZ-LLM	ISSAI NU, Ministry of Finance of the Republic of Kazakhstan, QazCode, Beeline KZ, Astana Hub	Llama architecture, versions 8B and 70B, quantized versions	95% of the data was collected and processed in Kazakhstan (websites, news, libraries)	Open source (non-comme-rcial use)	Creation of a sovereign AI foundation, preservation of cultural heritage, development of national expertise
YandexGPT	Yandex	Proprietary architecture integrated into the Yandex ecosystema	Special additional training on the corpus of Kazakh texts	Commercial API, free use in services	Expanding the linguistic coverage of a commercial product, providing services in the official language
ChatGPT	OpenAI	GPT-4 architecture, etc.	Learning from a huge multilingual corpus of data from the Internet	Commercial API, freemium model	Global reach, support for the maximum number of languages within a single model

Based on fundamental models and independent developments in Kazakhstan and beyond, a number of applications and platforms designed for learning the Kazakh language have appeared.

Comprehensive learning platforms:

Qonzhyq App: Positioned as the Kazakh equivalent of Duolingo. The app offers a gamified approach with scores, levels, and ratings for motivation. A distinctive feature is the presence of a large collection of Kazakh folklore (music, poems, fairy tales, lullabies), which allows you to develop listening skills and immerse yourself in culture. The target audience is very wide, from children to adults, including representatives of the Diaspora abroad.

Glossika: An international AI platform that uses a whole sentence learning method to develop fluency. It provides thousands of Kazakh sentences with translation and voiceover, adapting to the student's level (from A1 to B2) and allowing you to study at any convenient time.

Interactive AI tutors and chatbots:

Janymda (from Beeline): The Janymda superapp has implemented the «Kazaksha kasymda AI tutor» function (Kazakh nearby). This tool is based on the domestic KazLLM model. The training takes place in an interactive game format in the form of a chat with the AI, which offers to complete tasks: «make a sentence», «word game», «find a mistake», «continue the story» and others. The service is free and focused on family education. There are plans to add new languages and audiovisual materials.

Talkio AI: An innovative web application focused on developing oral skills. With the help of speech recognition and speech synthesis technologies, it allows you to conduct dialogues with AI, receiving instant feedback on pronunciation and phrase construction.

LangBuddy.ai: He presents himself as an «AI friend, a native speaker» with whom you can practice conversational skills through chat 24/7. The main focus is on improving sentence structure and fluency in informal communication.

SoilesAI (от Qazaq AI): An interesting example of the reverse application of technology is an AI chatbot designed for native Kazakh speakers to learn English. This demonstrates the bi-directional potential of the ecosystem being created.

Specialized tools and platforms:

Soyle App (от ISSAI): A fully Kazakh AI-based translator, available both as an application and via an API for integration into other services. This shows the use of AI not only for direct learning, but also for creating utilitarian language tools.

Tegeurin AI: A powerful platform offering a whole range of AI technologies for the Kazakh language: writing assistant (AI Writing), speech synthesis (Text-to-Speech), speech recognition (Speech-to-Text), morphological analyzer and others. It's more of a technology stack for developers and advanced users than a simple learning application.

ISSAI Offline systems: A unique set of innovative products capable of operating without an Internet connection, which solves the problems of data security and accessibility in regions with poor connectivity. It includes: Oylan 2.5 (multilingual smart assistant), MangiSoz 2.0 (speech to text conversion and audio translation), TilSync (subtitles for real-time video) and Beynele (image generation based on a text description in the Kazakh national style).

Educational and community initiatives:

Qazaq AI is a non-profit professional organization founded at MIT with a mission to promote the development of AI in Kazakhstan with a focus on cultural preservation. The organization oversees the projects JASANDY (a common AI platform in Kazakh), ErtegiAI (an AI generator of fairy tales for children), BilimAI (AI for science and education) and others, and also conducts educational activities through its «AI Academy».

The presented Table 2 briefly describes the characteristics of various applications and platforms for learning the Kazakh language. The table compares seven different tools across eight parameters, including their main focus and the availability of features such as conversational practice, gamification, pronunciation feedback, writing assistance, grammar exercises, cultural content, and the ability to work offline.

Table 2. Functional analysis of platforms and applications for learning the Kazakh language based on AI

Application / Platform	The main focus	Conversational practice	Gamification	Pronunciation Feedback	Help in writing	Grammar exercises	Cultural content	Offline capability
Janymda (AI- tutor)	Gamified Tutor	+	+		+	+		
Qonzhyq App	Comprehensive course (analog Duolingo)		+		+	+	+	
Talkio AI	Oral language development	+		+				
Glossika	Development of fluency of speech	+		+		+	+	+
LangBuddy.ai	Conversational practice	+			+			
Tegeurin AI	Technology stack			+	+			
ISSAI Suite (Oylan, etc.)	Specialized tools	+		+	+		+	+
Qazaq AI (ErtegiAI, etc.)	Educational projects				+		+	

The analysis showed that the Kazakh ecosystem of generative AI for the state language is in the stage of active development, but retains signs of fragmentation. Despite the presence of several language models, their level of maturity, stability, and data openness vary (see Table 1). A functional analysis of the applied solutions (see Table 2) showed that most of them are limited to basic dialog scenarios and do not implement a full-fledged educational methodology. This indicates a shift in emphasis from pedagogical tasks to the technical demonstration of AI capabilities, which limits their applicability in formal language education. Comparing the results with pedagogical principles revealed several key deficits:

- Personalization in most solutions is limited or absent, without taking into account the level of proficiency, age or learning style.
- The interactivity of dialogues is often imitative, without real language adaptation, full-fledged feedback or progress tracking.
- Feedback automation is mostly absent. AI does not offer corrective recommendations or analysis of typical errors.

The lack of methodically sound scenarios for the use of generative AI in teaching the Kazakh language hinders its systemic integration into the educational process.

In international practice, the use of generative AI in language education (e.g., ChatGPT, Duolingo Max, Speak AI, DeepL AI tutor) demonstrates a significantly higher level of adaptability, automated monitoring, assessment of progress, and multiformat content. These solutions are based on large language models (GPT-4, PaLM, LLaMA) optimized for educational purposes.

In comparison with international practices (for example, ChatGPT, Duolingo Max), Kazakhstani initiatives, although localized and specialized, are still inferior in the depth of pedagogical study. Nevertheless, the focus on Kazakh as a low-resource language provides unique opportunities for building an integrated methodological ecosystem with the support of the state and the academic community. This requires teachers to train not only the use of tools, but also their strategic integration to develop higher-order skills where AI is still weak (discussions, cultural context, pragmatics).

Conclusion. The analysis demonstrates that Kazakhstan is implementing an ambitious program to create a sovereign AI technological ecosystem for the Kazakh language, which is a national response to global challenges and aimed at ensuring linguistic sovereignty. At the center of this ecosystem is the powerful fundamental Kaz-LLM model and a number of pedagogically promising tools that successfully use interactivity, gamification, and instant feedback to increase motivation and learning effectiveness.

However, the study reveals a gap between the potential of the underlying technologies and their current implementation in applied solutions. The full range of AI capabilities, especially in the field of deep adaptive personalization and transmission of cultural and linguistic nuances, has yet to be revealed. This highlights the irreplaceable role of the teacher, whose task shifts to developing students' critical thinking and intercultural communication. For the Kazakh language, the chosen path opens up a unique opportunity to modernize the language education system and ensure its full-fledged future in the global digital space, becoming a model for other low-resource languages.

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