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OPTIMIZATION OF ADAPTIVE LANGUAGE LEARNING USING ARTIFICIAL INTELLIGENCE

The active penetration of digital technology into all spheres of human activity has naturally led to processes of transformation of the education system. In recent times, the growing interest around the possibility of using artificial intelligence (AI) in the educational space indicate the relevance of the topic. The aim is to analyze methods and technologies for optimizing adaptive learning of the Russian language as a foreign one based on AI. The theoretical significance is determined by its contribution to exploring various approaches to integrating AI into the educational process, as well as further investigating the effectiveness of using AI in adaptive language learning. The practical significance lies in the possibility of applying its main research results when introducing adaptive learning platforms and applications into educational institutions and developing recommendations for optimizing language teaching programs. During the study, scientific and methodological

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literature dedicated to the application of AI in education was analyzed, considering its prospects and potential risks, the effectiveness of various platforms and tools for adaptive language learning was assessed. The study determines the role of AI in personalizing the educational process, optimizing the content and forms of training, improving assessment methods and the pace of learning based on real-time feedback. The paper also identifies the ethical challenges and technical limitations faced by researchers and practitioners in the field of using advanced AI technologies in the educational process. The research results allow us to assert that AI technologies should become an integral part of the modern language learning process, as they can significantly enhance student motivation and develop their speaking skills. The results and study material can be used in lectures on cognitive linguistics, computational linguistics, semantics and pragmatics, as well as the development of educational programs and technology.

Key words: artificial intelligence, adaptive learning, education, technology, Russian as a foreign language (RFL).

MAIN PROVISIONS

The creation of a methodological foundation for studying and developing adaptive systems is the result of scientific research by representatives of different countries and generations. The principles of adaptive learning are based on cognitive psychology and constructivist theory, which assert that learning is most effective when it is personalized and interactive (Vygotsky, 1978; Piaget, 1970).

The main directions of this research topic include the integration of AI into educational technologies, the impact of personalized approaches on student motivation and performance (Aleven, Roll, & McLaren, 2016), and the comparison of traditional teaching methods with adaptive technologies based on student performance and engagement data (Baker & Inventado, 2014).

The theoretical framework of the research consists of scientific works dedicated to various aspects of adaptive learning using AI. Studies by Aleven V., Bostrom N., Goertzel B., Heffernan N., Karpova V., Kurzweil R., MacNish C., McCarthy J., Murphy R., Naumova V., Norvig P., Patel N., Ryan M., Ruchkina V., Sinelnikova V., Fulina V., and others are particularly significant for defining and classifying AI, educational analytics, and the application of technologies to enhance educational processes. AI is viewed as a powerful tool capable of shaping new paradigms in education and technological development (Holmes et al., 2019), integral to educational practices applied in intelligent learning systems and adaptive platforms (Chen, Xie, and Hwang, 2020). Research shows that AI promotes the shift towards personalized learning, altering the role of the educator (Baker et al., 2019; Starcic, 2019). However, simply using AI technologies is insufficient for ensuring a quality educational process (Castaneda and Selwyn, 2018); it is essential to consider the pedagogical and philosophical aspects of AI application (Hwang et al., 2020). Researchers point out the lack of critical reflection on the ethical consequences of AI implementation (Zawacki-Richter et al., 2019) and the gap between theory and practice in AI application (Deeva et al., 2021). Therefore, despite the considerable interest in AI in education, there is a need for further research to integrate theoretical foundations with practical implementations.

INTRODUCTION

The active penetration of digital technologies into all spheres of human activity has inevitably led to processes of transformation of the educational environment. Developing strategies for transforming and adapting the higher education system to new conditions raises issues related to unequal access to technology, confidentiality and security of personal data, and increasing the digital competence of students and teachers. Changes in education under the influence of a dynamically developing digital environment require the participation of university administrations, teachers and students, since updates affect all levels of education. Particular attention is paid to updating pedagogical technologies and teaching and learning tools to improve the quality of education and

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achieve new educational results [1]. Recently, the growing interest and heated debates around the possibility of using AI in the educational space indicate the particular relevance of this topic.

The object of the study is adaptive language learning, aimed at individualizing the educational experience of students. The subject of the research is the means for optimizing adaptive learning using AI.

In the modern educational space, the implementation of AI represents a significant breakthrough in the field of improving educational practices and enhancing the quality of learning. A particularly important aspect is the application of AI in adaptive learning, where personalization of the educational process becomes possible through data analysis and automated solutions. It is of undoubted interest to study the effectiveness of such technologies in the context of language learning, where individualization and selection of educational materials to the unique needs of students play a key role.

Steven Duggan defines artificial intelligence as “augmented intelligence” that allows all participants to receive and process the information needed to make better decisions [2, 12].

The development of AI system technology is often associated with the prospect of partially or fully replacing educators with AI. Thus, it seems that AI in education (AIED) is the use of “robots instead of teachers”. In fact, AIED encompasses a wide range of products, from personalized learning and dialogue systems to intelligent learning games, essay analysis, chatbots, and the technology of AI-based tutor selection.

In the article, AIED is defined as the application of various technologies such as intelligent learning systems, chatbots, robots and automated assessment of all forms of digital materials that support and enhance the learning process.

Among AI technologies in the field of education, the following should be highlighted: the Internet of Things, which makes it possible to create “distance learning laboratories”; additive manufacturing, including 3D printers, 3D modeling and production of robotics parts and devices; machine learning, which allows the use of “avatars and chatbots for consulting, testing and designing individual educational paths”; as well as big data technologies, blockchain and cloud computing, which contribute to “creating of secure portfolios for students and educators”, as well as recording the development of educational and professional competencies. In addition, virtual and augmented reality are applied in the educational process through various setups with elements of augmented reality [1, 84].

The research aim is to analyze methods and technologies for optimizing adaptive teaching of Russian as a foreign language (RFL) using artificial intelligence. To achieve this goal, the study defines the role of artificial intelligence in personalizing the educational process, optimizing the content and forms of training, improving assessment methods and the pace of learning based on real-time feedback. In addition to the technical and pedagogical aspects of integrating AI into the educational process, with a focus on creating innovative educational tools that can significantly improve the language learning process, the article also discusses ethical issues related to the use of AI data in the educational environment.

Research hypothesis. The application of AI for adaptive learning of Russian as a foreign language significantly increases the efficiency of the educational process by personalizing learning, considering the individual characteristics of students and providing instant feedback. This leads to improved academic performance, deeper understanding of the material, and increased student motivation compared to traditional teaching methods.

The theoretical significance of the study is determined by its contribution to exploring various approaches to integrating AI into the educational process, as well as further investigating the effectiveness of AI use in adaptive language learning. The practical significance of the research lies in the possibility of applying its main findings in implementing adaptive learning platforms and applications in educational institutions, and in developing recommendations for optimizing language learning programs. Studying the real-life experience of using AI in university classrooms provides valuable insights into the practical aspects of integrating AI into language teaching. The results and

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materials of the research can be used in lectures on cognitive linguistics, computational linguistics, semantics, and pragmatics, as well as in the development of educational programs and technologies.

MATERIALS AND METHODS

The issue of adaptive learning in higher education using AI has been actively studied in recent years. However, it should be emphasized that despite the success in developing adaptive systems, there are several insufficiently researched aspects and problem areas in adaptive learning and the application of AI in the educational space, since not all studies consider the diversity of educational contexts and individual characteristics of students. In the academic environment, there is insufficient data on the ability of AI to work equally effectively in different cultural and institutional settings, on methods for integrating AI systems into existing educational structures, and on the long-term effects of using AI in adaptive learning, since most research does not address the sustainability and consequences of such approaches. Unfortunately, issues of ethics and privacy of student data, possible algorithm biases, and potential inequality in access to quality education remain under-investigated.

Thus, despite a significant amount of research in the field of adaptive learning and the use of AI in education, the problem of improving the effectiveness of adaptive learning using AI remains insufficiently studied.

Within this study, the effectiveness of various platforms and tools for adaptive learning in studying Russian as a foreign language (RFL) was assessed. The focus was on the use of online services Duolingo and Rosetta Stone, which employ AI technologies to personalize the learning process, as well as platforms Knewton and DreamBox, which apply adaptive algorithms to analyze student data and personalize content. Additionally, chatbots were used in the study to provide interactive interaction with students.

During the research, an analysis of scientific and methodological literature was conducted on the use of AI in education, considering its prospects and risks. The next stage involved examining current methods for adaptive learning and AI technologies applied in education, along with reviewing successful cases of AI integration into educational processes. Further, AI services were studied for their functionality and potential for integration into the RFL learning process. Adaptive learning platforms and tools, interactive technologies were selected to create immersive learning environments and improve student engagement and motivation. An important stage of the research was to identify key metrics for assessing the effectiveness of adaptive learning with AI in RFL classes. Empirical experience with AI services in practical RFL classes was used to develop AI-based assignments. The next stage included observing the educational process and documenting changes in student performance and motivation. Data on student behavior and progress were applied as research material. A comparison between traditional teaching methods and AI-based adaptive learning was conducted in the control and experimental groups. After gathering learning outcome data, qualitative and quantitative analysis was performed using statistical methods to assess their impact on student academic achievement and motivation. The final stage of the research contained the interpretation of the data obtained and the formulation of conclusions of the work done.

RESULTS

The opportunities and prospects for using AI in the educational space are quite evident. Asserting the positive effects of implementing these technologies in education, it is necessary to note the following: automation of routine processes (such as educational process planning, grading assignments, or conducting exams); optimization of training courses through standardization of skills and competencies among students within disciplines; interactivity of teaching methods used and their orientation towards the individual learner; availability of information support by a virtual assistant at any convenient time for students; preference for indirect information acquisition via bots for some students; enhancement of human intelligence system functions for effective resolution of specific tasks [3].

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Within the framework of this study, adaptive learning tools for studying RFL employed the online services Duolingo and Rosetta Stone, using AI technologies to personalize the learning process, as well as Knewton and DreamBox platforms, applying adaptive algorithms for analyzing student data and personalizing content. For instance, in language learning apps such as Duolingo, AI can recognize the learner's speech. The algorithm analyzes grammar structures, vocabulary, pronunciation of words, and, in case of errors, provides with the correct option. Research shows that Duolingo users make noteworthy progress in language learning in a short time, thanks to the gamification approach and adaptive delivery system [4], and also highlights the high effectiveness of Rosetta Stone in improving speaking and listening skills through interactive and adaptive exercises [5]. These applications were chosen for research due to their popularity in language learning environments.

During the study, significant benefits of adaptive learning using AI for language learning were identified. These, first, include the individualization of the learning process: educational programs are adapted to the interests and abilities of each student, ensuring optimal speed and complexity of learning.

They analyze data on student progress and behavior to create personalized learning paths. AI and machine learning enable adaptive learning systems to investigate substantial amounts of data and predict what content will be most beneficial for each student. Connectionist networks are used for deeper data analysis and to create more accurate models of student behavior. At the same time, students receive instant real-time feedback on their assignments, which helps them correct mistakes faster and better understand the material. Thanks to continuous progress monitoring, tutors and students can track their progress and receive recommendations for further study.

Another important aspect of integrating AI into language learning is automated assessment tools that help analyze student performance and achievement. Using algorithms and machine learning, these tools can assess a wide range of students' linguistic competencies, from grammar and vocabulary to pronunciation and fluency [6]. An advantage of automated assessment is the availability of diagnostic feedback, which helps students identify gaps in their knowledge and focus on improving specific areas [7].

The study assessed engagement metrics and pre- and post-scores among students in both experimental and control groups using quantitative research methods. The results showed that the experimental group, which used AI-based platforms, had higher engagement metrics such as frequency and duration of engagement compared to the control one. Moreover, the scores of the experimental group had been significantly improved after assessment, indicating better language proficiency.

One of the most common AI applications to enhance the motivational factors of learning are chatbots. "It is a computer program equipped with AI capabilities that allows it to simulate human intelligence through text or voice." [8, 3]. The use of chatbots for linguistic practice is another example of innovative AI use in language learning. Since the methodology for teaching Russian as a foreign language aims to develop communicative skills among students, it seems appropriate to introduce chatbot technologies into the educational process that can effectively simulate real communication situations and provide students with the practice of dialogue interaction in Russian. The use of chatbots allows students to practice speech patterns and models, develop skills in social media communication, and helps overcome the psychological barrier when engaging in communication in Russian.

In addition to the fact that the use of chatbots as chatterbots reduces the level of anxiety, AI facilitates the work of tutors, assisting them in monitoring and developing materials [9, 168]. Moreover, learning can continue outside the educational institution, since computer technologies blur the boundaries between the formally organized educational process and those conducted in a more informal environment, such as at home [10].

Currently, the practice of learning RFL can apply the following digital tools based on AI technologies: AI services created with the help of automatic text processing; virtual tutors and chatbots designed to perform a wide range of tasks, as well as chatbots specially designed for RFL tasks (Alice, Mondly, MyRUSkey, Replika, RussianTutor).

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It is worth highlighting the capabilities of GPT-4 Omni, or simply GPT-4o, which simultaneously works with text, pictures, video and audio. For example, you can show it different objects and ask it to name them. You can communicate with this neural network as with a friend, since it imitates the human voice, and laughs, jokes, expresses emotions, changes intonation and even sings. Additionally, GPT-4o's real-time speech-to-text and translation capabilities enhance the accessibility of live broadcasts.

The analysis of chatbots used as conversational trainers to develop communicative skills in learning RFL highlights their advantages: 1) creating communicative situations that are difficult to reproduce in a learning environment; 2) practicing speaking skills in real-time with instant feedback; 3) developing communicative abilities through gamification; 4) automated verification of students' independent work.

Separately, the gamification should be highlighted for language learning, which employs the motivational power of games to improve learning outcomes. Educational applications designed for educational purposes combine engaging game elements with structured language learning activities, thereby promoting the development of sustainable student engagement and deeper immersion in the language [6].

This study contributes to the knowledge base on the effectiveness of adaptive learning systems for teaching Russian as a foreign language using AI. Examining real-world experiences with AI services in university classes provides valuable insights into the practical aspects of integrating AI into language teaching. The prominent levels of engagement of the experimental group and significant increases in learning outcomes indicate the potential of these services and tools to change traditional educational approaches. The study supports the hypothesis that personalized, technologically enhanced learning experiences can provide significant benefits. However, long-term implementation of these systems requires careful consideration of ethical and social issues, as well as training and support for educators to work in such technologically supported contexts.

DISCUSSION

In modern society, one of the key areas for optimizing learning is the creation of educational systems that adapt to the needs and requirements of students. Adaptive learning is an educational approach that uses technology and analyzes student data to provide each student with a personalized learning experience not available in traditional classrooms. The main idea is to adjust learning materials, methods and learning speeds to the needs and preferences of each student. In this context, the use of AI technologies, especially neural networks, represents a promising direction in creating adaptive educational platforms of a new generation.

Neural networks, being a special type of computational models inspired by principles of the human brain, are capable of self-learning through analysis of large datasets and making informed decisions under conditions of uncertainty. Their flexibility and adaptability make them ideal tools for creating educational programs that can adjust to the individual requirements and needs of each student. "Since students have different learning styles, providing diversity in the learning environment will enhance the effectiveness of perception and retention of knowledge" [11, 1469].

It should be noted that there is no consensus in academic circles regarding the effectiveness of adaptive educational systems in higher education, which is explained not only by limitations in empirical data, but also by inherent issues in adaptive learning overall. Among the latter, the following can be highlighted: "a limited range of disciplines for adaptation, difficulties in measuring complex constructs, the need to invest large financial and time resources, limited adaptation capabilities" [12, 20]. However, it is important to emphasize that the field of adaptive learning is evolving so rapidly that the pace of scientific research may not keep up with these changes.

The growth in the use of AI in the educational space has generated both excitement and concern in society, highlighting the urgent need to study its implications. However, everyone realizes that it is impossible to completely prohibit students from using AI. The irrationality of banning on the use

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of ChatGPT in the educational environment can be explained by the following reasons: the inconsistency of such an approach, the potential of AI as an effective educational tool, and the need to prepare today's students for life in the era of AI.

It is quite reasonable to assert that "by 2030, AI will learn to assist tutors, collaborate with them and act as a mediator between them and students" [13].

At the same time, there is no doubt that the integration of AI into modern educational spaces poses a number of risks for the effectiveness of the leducational process and the well-being of all its participants. These risks include: unequal access to AI technologies, which leads to a "digital divide" among participants in the educational process; the problem of ensuring the confidentiality and security of accumulated data; decreased cognitive and creative abilities of students due to increased dependence on technology; the limited ability of modern AI systems to perceive and adequately respond to a wide range of emotional and psychological states of participants in the educational process [1].

Ethical considerations, data security issues, and the potential impact on the educational environment are integral to the discussion of the role of AI in education. Addressing these issues is essential for AI to become a useful tool in language education and help make it accessible and equitable for everyone [14].

CONCLUSION

Based on the data analysis and discussion presented in this study, we can draw the following conclusions: adaptive learning using artificial intelligence technologies demonstrates high effectiveness in learning Russian as a foreign language. Modern AI services and tools can significantly improve the academic achievements of students, increase their motivation and involvement in the educational process, and optimize the time spent on studying educational material.

AI also has high potential to provide personalized feedback to students in real time and more objectively evaluate student learning outcomes. One of the key findings of the study is that students learning using adaptive AI systems show significant improvements in test and exam scores. Personalized learning paths allow students to focus on the areas where they struggle most and progress effectively as they master new material. However, it is important to consider that such results may depend on the quality and accuracy of the algorithms used in adaptive systems.

The educational content should be structured by a network considering the didactic features of the training course, learning and adaptation strategies, cognitive abilities, the level of basic knowledge and the pace of forgetting and memorizing of the student.

The results of the study show that AI technologies make a significant contribution to the development of student-centered and interactive learning at the university. It should be emphasized that AI cannot replace a professional tutor but can become an extremely useful assistant for improving the learning process.

Along with the positive aspects, the research process has identified certain challenges and limitations that require careful consideration and further study. It is important to consider and address the risks associated with the use of technology, as well as adhere to ethical standards such as personal data privacy, fairness, and accessibility of education. More successful integration of AI in language teaching requires careful planning of the process, as well as appropriate digital training and social support for tutors. In the future, further development of AI and increased availability of technology will open new opportunities for adaptive learning and its integration with traditional methods. The higher education system as a social institution needs to rethink its functions and pedagogical models in the light of the significant prospects offered by the application of AI tools in the educational process.

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Жасанды интеллекті пайдалану арқылы тілді бейімдеп оқытуды оңтайландыру

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Цифрлық технологиялардың адам қызметінің барлық салаларына белсенді енуі, әрине, білім беру жүйесін трансформациялау процестеріне әкелді. Білім беру кеңістігінде жасанды интеллектті (ЖИ) пайдалану мүмкіндігі туралы соңғы уақытта өсіп келе жатқан қызығушылық пен қызу пікірталас осы тақырыптың ерекше өзектілігін көрсетеді. Бұл зерттеудің мақсаты – жасанды интеллектті қолдану арқылы орыс тілін шет тілі ретінде бейімдеп оқытуды оңтайландыру әдістері мен технологияларын талдау. Жұмыстың теориялық маңыздылығы оның жасанды интеллектті оқу үдерісіне кіріктірудің әртүрлі тәсілдерін түсіндіруге қосқан үлесімен, сондай-ақ тілді бейімдеп оқытуда жасанды интеллектті қолданудың тиімділігін одан әрі зерттеумен айқындалады. Зерттеудің практикалық маңыздылығы оның негізгі нәтижелерін оқу орындарына бейімделген оқыту платформалары мен қосымшаларын енгізу және тілдерді оқыту бағдарламаларын оңтайландыру бойынша ұсыныстар әзірлеу кезінде қолдану мүмкіндігімен анықталады. Зерттеу барысында білім беруде жасанды интеллектті қолдану бойынша оның келешегі мен ықтимал қауіп-қатерлері ескеріле отырып, ғылыми-әдістемелік әдебиеттерге талдау жасалып, тілді бейімдеуге арналған түрлі платформалар мен құралдардың тиімділігі бағаланды. ЖИ негізіндегі тапсырмаларды әзірлеу үшін шет тілі ретіндегі орыс тілі практикалық сабақтарында ЖИ-қызметтерін пайдаланудың эмпирикалық тәжірибесі пайдаланылды. Зерттеу жасанды интеллекттің білім беру үдерісін дербестендірудегі, оқытудың мазмұны мен нысандарын оңтайландырудағы, бағалау әдістері мен нақты уақыттағы кері байланыс негізінде оқыту қарқынын жақсартудағы рөлін анықтайды. Сондай-ақ, мақалада зерттеушілер мен практиктердің оқуда жасанды интеллект технологияларын пайдалану кезінде кездесетін этикалық қиындықтары мен техникалық шектеулері анықталған. Зерттеу нәтижелері ЖИ технологиялары қазіргі тілді оқыту процесінің органикалық бөлігіне айналуы керек екенін көрсетеді, өйткені олар студенттердің ынтасын айтарлықтай арттырып, сөйлеу дағдыларын дамыта алады. Университеттегі сабақтарда ЖИ қолданудың нақты тәжірибесін зерделеу тілдерді оқытуда ЖИ енгізудің практикалық мүмкіндіктері туралы құнды түсінік береді. Зерттеу нәтижелері мен материалдарын когнитивтік лингвистика, компьютерлік лингвистика, семантика және прагматика бойынша лекцияларда, сондай-ақ білім беру бағдарламалары мен технологияларын әзірлеуде пайдалануға болады.

Кілт сөздер: жасанды интеллект, бейімдеп оқыту, білім беру, технология, шет тілі ретіндегі орыс тілі

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Оптимизация адаптивного обучения языку с использованием искусственного интеллекта

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Активное проникновение цифровых технологий во все сферы человеческой деятельности естественным образом привело к процессам трансформации системы образования. Растущий интерес и бурные дискуссии в последнее время вокруг возможности использования искусственного интеллекта (ИИ) в образовательном пространстве свидетельствуют об особой актуальности данной темы. Целью данного исследования является анализ методов и технологий оптимизации адаптивного обучения русскому языку как иностранному с применением искусственного интеллекта. Теоретическая значимость работы определяется ее вкладом в выяснение различных подходов к интеграции искусственного интеллекта в образовательный процесс, а также дальнейшее изучение эффективности использования искусственного интеллекта в адаптивном обучении языкам. Практическая значимость проведенного исследования заключается в возможности применения его основных результатов при внедрении адаптивных учебных платформ и приложений в образовательные учреждения и разработке рекомендаций по оптимизации программ обучения языку. В процессе исследования была проанализирована научно-методическая литература, посвященная применению искусственного интеллекта в образовании с учетом его перспектив и возможных рисков, проведена оценка эффективности различных платформ и инструментов адаптивного обучения языку. Для разработки заданий, основанных на ИИ, использовался эмпирический опыт применения ИИ-сервисов на практических занятиях по русскому языку как иностранному. В рамках исследования определяется роль искусственного интеллекта в персонализации образовательного процесса, оптимизации содержания и форм обучения, усовершенствовании методов оценивания и темпа обучения на основе обратной связи в реальном времени. В работе также определяются этические вызовы и технические ограничения, с которыми сталкиваются исследователи и практики в области использования новейших технологий искусственного интеллекта в процессе обучения. Полученные результаты исследования позволяют утверждать, что технологии ИИ должны стать органичной частью современного процесса обучения языкам, так как они могут значительно повысить мотивацию учащихся и развить навыки их речевой деятельности. Изучение реального опыта использования ИИ на занятиях в университете дает ценную информацию о практических аспектах внедрения ИИ в преподавание языков. Результаты и материалы исследования могут быть использованы в лекциях по когнитивной лингвистике, компьютерной лингвистике, семантике и прагматике, а также разработке образовательных программ и технологий.

Ключевые слова: искусственный интеллект, адаптивное обучение, образование, технологии, РКИ.

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