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ARTIFICIAL INTELLIGENCE IN THE SYSTEM OF HIGHER EDUCATION IN MODERN RUSSIA AND THE STATES OF THE FORMER USSR

INTELIGENCIA ARTIFICIAL EN EL SISTEMA DE EDUCACIÓN SUPERIOR EN LA RUSIA MODERNA Y LOS ESTADOS DE LA EX URSS

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ABSTRACT

The article examines the role of artificial intelligence (AI) in modern curricula of higher education institutions in Russia and some countries of the former USSR. The authors analyze the importance of understanding AI and justify the need to introduce information about it and its methods into the educational activities of universities. The authors pay special attention to the comparison of advantages and challenges of the use of AI. These challenges are mainly related to ethical issues, bias problem, data confidentiality and the need to retrain teachers to work with new technologies. Here the authors provide methods to overcome the identified risks. The team of authors also provides an overview of the current requirements of the Russian market for the training of specialists in the field of AI, as well as curricula on AI in leading Russian universities. At the end of the paper, the authors also provide an overview of the educational market in the field of AI in Kazakhstan, Azerbaijan, and Belarus. In conclusion, the authors list the tools that will contribute to the effective implementation of AI in education.

Keywords:

Artificial intelligence, higher education, curriculum, data science, competence assessment.

RESUMEN

El artículo examina el papel de la inteligencia artificial (IA) en los planes de estudio modernos de las instituciones de educación superior en Rusia y algunos países de la antigua URSS. Los autores analizan la importancia de comprender la IA y justifican la necesidad de introducir información sobre ella y sus métodos en las actividades educativas de las universidades. Los autores prestan especial atención a la comparación de las ventajas y desafíos del uso de la IA. Estos desafíos están relacionados principalmente con cuestiones éticas, problemas de sesgo, confidencialidad de los datos y la necesidad de volver a capacitar a los docentes para trabajar con nuevas tecnologías. Aquí los autores proporcionan métodos para superar los riesgos identificados. El equipo de autores también proporciona una visión general de las necesidades actuales del mercado ruso para la formación de especialistas en el campo de la IA, así como los planes de estudio sobre IA en las principales universidades rusas. Al final del artículo, los autores también ofrecen una visión general del mercado educativo en el campo de la IA en Kazajstán, Azerbaiyán y Bielorrusia. En conclusión, los autores enumeran las herramientas que contribuirán a la implementación efectiva de la IA en la educación.

Palabras clave:

Inteligencia artificial, educación superior, currículo, ciencia de datos, evaluación de competencias

INTRODUCTION

At the most basic level, artificial intelligence (AI) is the process of using computers and other machines to simulate human perception, decision-making and other processes to complete a task. In other words, AI is when machines participate in high-level pattern matching and learning in the process.

There are several different ways to understand the nature of artificial intelligence. AI exists on the basis of machine learning rules. It means that decision-making rules are used to make a recommendation or decision – it is the most basic form. An example of such a system in the field of education is the Intelligent Learning System (ITS), which can provide students with detailed and specific feedback (Itinson, 2020; Swargiary, 2023).

Machine learning-based AI is more powerful because machines can really progress and get better over time, especially when they interact with large multi-level datasets. In the case of education, artificial intelligence tools based on machine learning can be used for various tasks, such as monitoring student activity and creating models that accurately predict student outcomes (Timokhin, 2022). Although machine learning-based AI is still emerging, this approach has already shown impressive results when it comes to complex decisions that are not defined by rules, such as evaluating written student responses or analyzing large and complex datasets.

There are other important differences within artificial intelligence, largely based on technological use cases. One subfield revolves around natural language processing (NLP), that is the use of machines to understand text. Technologies such as automatic essay evaluation use NLP to evaluate written essays (Timokhin, 2022). Also important in AI are recommendation and other forecasting systems that participate in data-based forecasting (Timokhin, 2022). For example, Netflix currently uses an AI-based recommendation system to offer its users new movies.

AI based on an optical system is also an important area that can help in evaluation. A number of assessment groups used optical systems to evaluate the work of students (Timokhin, 2022). For example, instead of the teacher evaluating a mathematical equation written by a student, the teacher can take a picture of the equation and the machine will evaluate it. Finally, there are artificial intelligence systems based on voice recognition. These systems are the basis of NLP tools such as Siri and Alexa, and experts are exploring ways to use voice-based artificial intelligence to define reading and other learning problems (Xue & Wang, 2022).

Today, the use of machine AI has already quite disseminated in education. For example, several testing companies, such as Education Testing Service and Pearson, use NLP to evaluate essays. Massive open online courses allowing unlimited participation over the Internet, conducted by companies such as Coursera and Udacity, have also integrated AI assessment for essay analysis into their courses.

MATERIALS AND METHODS

This study employed a mixed-methods research approach to comprehensively investigate the role and implementation of artificial intelligence (AI) in higher education across Russia and select former USSR countries. The research was conducted through a multi-step process, encompassing data collection, analysis, and synthesis of findings.

A comprehensive review of existing academic literature and reports related to AI in education was conducted to establish a foundational understanding of the subject and identify key research gaps.

Curricula of leading Russian universities offering AI-related programs were analyzed to understand the specific courses and educational content designed for AI education.

It's important to note that this study's scope primarily encompassed Russia and select former USSR countries, which may limit the generalizability of the findings to other regions. Additionally, the dynamic nature of AI technology and education may result in findings that evolve over time.

The research approach employed in this study allowed for a comprehensive exploration of AI in higher education, yielding valuable insights into its current status, challenges, and opportunities across Russia and select former USSR countries.

The mention of AI is reminiscent of a supercomputer – a computer with huge computational capabilities, including adaptive behavior, such as the inclusion of sensors, and other facilities that allow AI to have human cognition and functional abilities, and really improve the interaction of supercomputers with people. In the field of education, the use of AI has increased, going beyond the traditional understanding of AI as a supercomputer that includes embedded programs.

Despite the notorious negative discussion of testing in schools (Rakitov, 2018), assessment is a necessary and useful tool in the process of teaching and learning. This is especially true when it comes to diagnostic and formative assessments, which give teachers real-time guidance on what students need to learn in order to master the course content. There advanced technology can particularly

benefit teaching and learning, as there is a growing re-cognition in the field of psychology that tests help students to learn. This theory, sometimes called the testing effect, suggests that quizzes help students gain knowledge and improve the quality of learning.

Advances in technology have led to new developments in the field, such as hidden assessments, which reduce some of the stress students may experience during tests. This approach makes testing more common and useful for teachers because the methods are embedded into the learning process and are invisible to students.

AI can help students to learn better and faster with high-quality learning materials (Sadykova & Levchenko, 2020). In some cases, such as automatic essay evaluation, tea-chers and students do not take advantage of these tools directly.

Despite all the advantages of AI, there are clear concerns about its use. One of the main problems is related to con-fidentiality. How do these tools protect user privacy? How do schools get the consent of students and parents when implementing AI? Should anonymous data be provided to researchers and other external groups? Another question is the value of social and emotional connections and the very human experience of education. Simply put, AI will not replace teachers. Experts also point to bias as a di-sadvantage of AI. Assessment conducted by machines will be based on the results of thousands of tests. But test results more often reflect a lack of opportunities than a lack of capabilities. Machine evaluation will not be able to make these distinctions.

Bias occurs when a student's response is misinterpreted and, therefore, misjudged and evaluated incorrectly. Bias against AI manifests itself in 4 forms:

- Incoming data contains built-in bias. That is, poor re-sults, such as low scores, may be the result of fewer learning opportunities for students, rather than diffe-rences in capabilities.

- Poor performance in the past predicts poor performan-ce in the future. For example, students who have per-formed poorly in the past will repeat this.

- The use of AI generates uncertainty about the fairness of the results. Since the incoming data may have bias, the results may also be biased.

- The use of AI continues the old inequality, and gaps in access to opportunities to achieve high levels remain.

- Experts agree that bias in training of AI will always exist (Korovnikova, 2021). Therefore, eliminating bias may be the wrong goal. Instead, policymakers who oversee testing systems should ask themselves what kind of bias is acceptable, and how to ensure that bias does not disproportionately affect students based on race, ethnicity, income, disability, or other status.

Three steps will bring teachers and students closer to ta-king advantage of AI and its use in student assessment.

First, the government should invest in research to un-derstand better where and how bias occurs in testing (Kazarina, 2021). The test results should be an honest and accurate reflection of what students know and can do, compared to a generally accepted and fair standard. But when test results consistently demonstrate racial cha-racteristics – and do not reflect the true differences bet-ween groups – they are biased. Bias can manifest itself in what is measured or in how it is measured and evaluated. Research can point out how bias occurs in the testing pro-cess and help find ways to correct it.

Secondly, the government should invest in the develop-ment of new types of assessment based on technology. Thus, it is necessary to provide additional funding for tes-ting and related research and development of advanced technologies, such as AI-based tools, educational games, and virtual reality (VR).

Third, the government should invest in the professional training of teachers on the effective use of AI. Teachers should be experts in creating their own assessments, as well as in using the results of any assessments to support students' learning individually.

Many AI-systems attempt to provide learning by simula-ting a real work environment (in the form of VR) where a student can learn a task. There are many reasons for de-veloping such systems, including the possible danger of learning on real equipment and the lack of specialists in the subject area who could devote their expensive time to train beginners. Thus, a realistic simulated learning environment can reduce both the cost and the risks of learning.

An example of ITS based-on modeling is the Advanced Cardiac Life Support (ACLS) Tutor, in which a student as-sumes the role of a team leader for providing emergency life support to patients who have suffered a heart attack. The system not only tracks the actions of students, but also runs a lifelike simulation of the patient's condition and maintains an environment that closely matches the "real life" situation. Thus, the goal is not only to test the student's knowledge of the correctness of actions in emer-gency situations, but also to give him/her the opportunity to work out these actions more realistically than is possible in an ordinary classroom.

Introduction of Artificial Intelligence in Russian Higher Education Institutions

The liberalization of various social spheres Russia has also affected the field of education. One of the new directions of the improving of the education quality is the development of distance learning, which expands the learning opportunities of schoolchildren and students. The introduction of information technologies (IT), including AI in educational activities allows to improve the quality and efficiency of learning resources. "The artificial intelligence system of the educational process should include the following elements" (Bogomolov et al., 2020):

- a search information system that formulates a database of the educational process from various sources;

- constantly updated electronic library;

- knowledge level control system;

- automatic scheduling;

- a system that provides communication between the student and the educational institution.

Russia is developing and implementing world-class educational programs to train highly qualified specialists and managers in the field of AI, as stipulated by the National Strategy for the Development of Artificial Intelligence until 2030, which was enshrined by President Vladimir Putin. The document defines AI as technological solutions capable of simulating human cognition and performing intellectual tasks similarly or better than humans.

First of all, promising curricula should be elaborated taking into account the constantly changing trends in the industry. They should equip graduates with skills that meet both current and emerging market needs. Experts consider practice-oriented education and cooperation between the scientific community and high-tech business to be the key for creating professionals in the field of AI (President of the Russian Federation, 2019).

Any training program for specialists in such a rapidly changing field as artificial intelligence should be constantly updated, and business partners should cooperate both by providing individual specialists acting as instructors and by creating full-fledged corporate educational programs (Shananin & Andrianova, 2022).

Accordingly, at ITMO University, master's programs in AI are implemented using a project approach that allows one to personalize curriculum. Students are invited to participate in real projects implemented by the university's corporate partners and choose which subjects to study in connection with their project activities. This allows them to develop specialization and gain work experience in Russian leading companies, including Gazprom, Mail.Ru, MTS and Sberbank.

ITMO University has several educational programs related to the study and use of artificial intelligence: "Deep Learning and Generative Artificial Intelligence" (master's degree), "Robotics and Artificial Intelligence" (master's degree), "Chemistry and Artificial Intelligence" (master's degree), "Computer Technology: Programming and Artificial Intelligence" (bachelor's degree) (Artificial Intelligence, 2022).

Moreover, the master's program "Artificial Intelligence in Industry" has been launched at ITMO this academic year. Specialists who will be able to develop and implement digital solutions based on modern AI methods in many industries will be trained there. This master's program has been developed jointly with industrial partners, one of which is the Gazprom Neft Scientific and Technical Center. *".. during their studying, students can work on company projects, and after graduation, they will be able to get a job in R&D departments or analytical departments of large industrial corporations*," writes ITMO.NEWS – the media of the university.

At MIPT, AI trainees also acquire practical skills by participating in real R&D projects, as the university cooperates with leading Russian research, infrastructure, and high-tech companies: ABBYY (software developer), Innopolis University, HSE, Russian Railways, Rostelecom, Sberbank, Skolkovo Institute of Science and Technology, Federal Biomedical Agency, and others.

Moreover, MIPT offers distance learning under the program "Modern Methods of Artificial Intelligence" (2022). The program is based on cooperation with leading Russian and foreign research institutes dealing with information technology, data science and machine learning, such as ABBYY, Runa Capital, Huawei, Acronis, IBM, Intel and Yandex. This online program aims to introduce students to the current stage of machine learning and artificial intelligence. It provides comprehensive practical experience and creates a thorough theoretical basis. Combined, these skills and knowledge are becoming very valuable in the rapidly developing field of AI. The main aspects studied in the learning process: the basics of AI, ways to build effective and stable technical solutions, cloud computing, etc. A student who has completed this course will be able to:

- reformulate real (for example, business) problems in technical language and understand the appropriate approaches to them;

- understand when and how to apply appropriate machine learning methods;

- extract useful ideas from data and present them in an informative form;

- create stable and efficient software and reliable data storages;

- distribute cloud computing.

Saint Petersburg State University is no exception and also offers a master's program in the field of AI studies (Artificial Intelligence and Data Science, 2023). In this educational program, disciplines are taught by representatives of large industrial companies and organizations as well. Students can take part in real interdisciplinary projects that involve the application of the acquired knowledge in practice, what will help students to test their capabilities in business. The learning process includes a special block of disciplines "Artificial Intelligence for the Arctic Region", which implies a more detailed study of the use of AI technologies to solve economic, social, and state problems in the Arctic territories of the Russian Federation. Students are also given the opportunity to create AI-projects themselves together with leading specialists of the university.

Moreover, a number of universities across Russia provide master's programs in the field of AI studies: Data Sciences (2022), "Data Analysis and Artificial Intelligence" (Innopolis University) (2022), "Robotics and Computer Vision" (Innopolis University), "Modern Methods of Artificial Intelligence" (MIPT) (2022), "Innovative Software Systems. Design, Development and Application" (MISIS), "Mechatronics and Robotics" (SUSU), "Artificial Intelligence in the Electric Power Industry" (UFA) and some others.

However, even trained specialists will need to be retained, and Russian companies should be able to cope with this. In Russia, there is a great demand for highly qualified AI specialist from large corporations (Slavyanov & Feshina, 2019), both domestic (Mail.Ru, Sberbank, Yandex), and international (China, Middle East, Turkey, CIS, etc.), as well as high-tech startups. But despite this, Russian specialists often leave the country, finding more profitable offers abroad.

The development of AI is largely driven by the needs of the industry since AI research has no market value if it is not applied to solving industry problems. Therefore, its future, apparently, is connected with the development of industrially oriented solutions and decision-making systems aimed at strengthening human intelligence.

Artificial Intelligence in Educational Programs of the Former USSR States

At the end of 2019, the Institute of Smart Systems and Artificial Intelligence (ISSAI) was founded in *Kazakhstan*

to serve as an engine of research and innovation in the digital sphere with a focus on AI research. ISSAI conducts interdisciplinary research in the field of machine learning to solve industrial and social problems. The Institute strives to develop national potential for research in the field of AI, using the experience of Asia, Europe, and the USA (Pavlyuk, 2020). ISSAI provides a flexible framework for research, innovation, and collaboration with national and foreign partners in education, industry, and government ruling as well as contributes to the digital sphere of Kazakhstan to achieve national development goals.

ISSAI conducts a wide range of research projects focused on the study and development of AI in the field of healthcare, industry, etc. The Institute is developing projects to improve the quality of life, accelerate the detection of various diseases: optical tactile sensors, human memory expansion based on augmented reality (AR) using AI, multilingual speech recognition, disease detection with internal navigation, automatic segmentation of tumors, etc.

Azerbaijan is another successful example of the introduction of educational programs in the field of AI. The reason is that that the technological transformation is now going through the industry of extraction and sale of energy resources – a key industry for the country's economy. The leading universities in computer science and AI education in Azerbaijan are now the Azerbaijan State University of Oil and Industry, Baku State University, Azerbaijan Technical University, Azerbaijan University, Khazar University, and the Azerbaijan Diplomatic Academy (ADA). In the latter, despite a different profile, much attention is paid to Big Data research, the use of AI and technological entrepreneurship programs. The private university Azerbaijan University also offers a wide range of training in the field of computer science: convolutional, recurrent, and other artificial neural networks (ANNs), NLP, cognitive computing, data analysis, genetic algorithms, machine learning.

In addition, Azerbaijan has launched several initiatives to promote innovation in the field of AI. As part of these initiatives, an AI Research Center has been established, which develops advanced technologies and promotes cooperation between scientists, business, and government. Continuing AI development, Azerbaijan has also signed agreements with IT giants such as Microsoft and Huawei. The parties agreed on assistance in the field of AI, blockchain and the Internet of Things (IoT). Currently, Azerbaijan and Pakistan are also approaching each other in order to exchange experience in the field of AI.

An AI Lab was launched in Azerbaijan in 2022 by the Ministry of Digital Development and Transport. Here they are engaged in in-depth study of machine learning, Data

Sconce, NLP, computer vision, programming, statistics, etc.

Finally, its significant to discuss AI in the educational field in *Belarus* and provide more detail about the leading university in the field of AI here, such as the Belarusian State University of Informatics and Radioelectronics (BSUIR). In the national education system of the Republic of Belarus, BSUIR plays a leading role in the training of engineering and scientific personnel in the field of computer science, radio electronics and telecommunications. Today BSUIR is a major scientific and educational center of Belarus. The University offers several departments for studying AI: Computer-Aided Design, Information Technology and Control, Radioengineering and Electronics, Computer Systems and Networks, Telecommunication, Engineering and Economics. Besides, BSIUR has lots of foreign partners in the field of developing innovative technologies. Among these partners are Chinese, Russian, and European universities and scientific laboratories.

Currently, the university has 55 research laboratories and research groups, including the Center "Nanoelectronics and New Materials". They conduct research in the following areas:

- Radio engineering devices and systems;

- Information processing and data transmission systems;

- Advanced information technology and control systems;

- Micro- and nanoelectronics;

- New materials, energy- and resource-saving technologies;

- Certification, diagnostics and testing of elements, devices and systems;

- Modeling and optimization methods in electronic systems and devices;

- Information and training technologies in education;

- Radiation technologies and mechanical engineering.

In this section, we have identified those countries that has made the most noticeable progress in the development of educational programs in the field of AI. It is remarkable, that interest to AI in the field of education depends on the economic well-being of the country: Kazakhstan, Belarus and Azerbaijan follow Russia in the ranking of GDP among the CIS countries [29]. The Baltic states did not appear among the countries for analysis, since, according to the widespread Russian view of political geography, they are not a post-Soviet space [28]. The analysis showed that the leaders of not all countries of the former USSR yet has realized the need to for students of higher educational institutions to learn AI to or do not have the financial capabilities

and human capital for this. Cooperation with Russia and other post-Soviet countries can help them to overcome these problems.

CONCLUSIONS

Well-designed formative assessments that use the latest advances in technology can help students learn faster and better. These mechanisms are also an important part of the teaching and learning process. Mini-tests created with the help of artificial intelligence – from intelligent learning, hidden assessments, games, and VR – can provide a wide range of ways to use this technology to create attractive tools. To achieve this, the education system needs to invest more actively in research and development of new testing technologies that can provide teachers and students with the tools they need.

Another difficulty in developing intelligent learning systems is the time and cost required. To create just one ITS there need to be a large team, including programmers, qualified experts, and specialists in educational theory. Accordingly, there is a need to find new methods that will help alleviate these learning difficulties.

With the help of AI tools, classes can become globally accessible to all students, even for those who have some disabilities or speak different languages (Chulyukov & Dubov, 2020). AI opens up new opportunities for students who need to study at different levels or who want to study a subject that is not available in their school. AI can break down the disparity between traditional levels of education and schools. AI can also help teachers create intelligent content that makes teaching and learning more comfortable for them and students.

Summing up, we can conclude that everyone who is familiar with global trends in different industries knows that personalization comes first. This is due to the emergence of AI, which is an advantage for the education sector. AI helps teachers improve their activity by providing them with all the necessary information. It also allows teachers to create content that best suits their students while providing personalized learning. AI automates tasks, so teachers have more time to learn and have a better impact on students.

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