Relações Internacionais do Mundo Atual – unicuritiba

O IMPACTO DAS REDES NEURAIS NAS POLÍTICAS E PRÁTICAS DO PROCESSO EDUCACIONAL PARA FORMAÇÃO DE ESPECIALISTAS MODERNOS

THE IMPACT OF NEURAL NETWORKS ON POLICIES AND PRACTICES IN THE EDUCATIONAL PROCESS FOR TRAINING MODERN SPECIALISTS

DARIA SEMENOVA

Moscow City University, Moscow, Russia. https://orcid.org/0000-0002-3709-9804 E-mail: dsemenova@mymail.academy

MIKHAIL BORODIN

Saint-Petersburg University of State Fire Service of Emercom of Russia – Russia. https://orcid.org/0000-0002-7416-3844 E-mail: michaelborodin@mail.ru

NATALIA SHAFAZHINSKAYA

K.G. Razumovsky Moscow State University of Technologies and Management (the First Cossack University) – Russia. https://orcid.org/0000-0002-9114-6499 E-mail: shafazhinskaya@mail.ru

IRINA VASLAVSKAYA

Kazan Federal University – Russia. https://orcid.org/0000-0002-1363-3865 E-mail: vaslavskaya@yandex.ru

VITALII VASYUKOV

Moscow State Institute of International Relations (University) – Russia. https://orcid.org/0000-0003-0743-5616 E-mail: vvf0109@yandex.ru

RESUMO

Objetivo: Analisar as oportunidades e riscos associados ao uso de redes neurais (NNs) no ensino superior, com foco em sua aplicação no aprendizado, gestão administrativa e personalização de experiências educacionais.

Método: O estudo utilizou pesquisa documental e um levantamento com 40 especialistas. Os critérios de seleção incluíram publicações relevantes sobre o tema. As respostas dos especialistas foram analisadas usando o coeficiente de concordância de Kendall para avaliar as oportunidades e riscos das NNs.

Resultados:
- **Oportunidades:**
    1. Assistência no aprendizado, como personalização e feedback.
    2. Apoio em tarefas administrativas, como avaliação e monitoramento de alunos.
    3. Análise de grandes conjuntos de dados para gestão institucional.
- **Riscos:**
    1. Consequências imprevistas dos processos de aprendizado automatizados.
    2. Aplicação de teorias inadequadas.

3. Algoritmos que atribuem tarefas impróprias aos estudantes.

Conclusão: As NNs oferecem grande potencial para melhorar a educação, especialmente ao liberar educadores de tarefas rotineiras. No entanto, sua implementação deve ser guiada por ética e transparência, priorizando o papel complementar dos professores e abordando os riscos identificados para evitar impactos negativos no aprendizado.

Palavras-chave: Redes neurais artificiais; Ensino superior; Aprendizado; Estudantes; Professores.

ABSTRACT

Objective: To analyze the opportunities and risks of using neural networks (NNs) in higher education, focusing on their application in learning, administrative management, and personalization of educational experiences.

Method: The study employed desk research and a survey of 40 experts. The selection criteria included relevant publications on the topic. Expert responses were analyzed using Kendall's coefficient of concordance to assess the opportunities and risks of NNs.

Results:
- **Opportunities:**
  1. Learning support, including personalization and feedback.
  2. Assistance in administrative tasks, such as assessment and student monitoring.
  3. Analysis of large datasets for institutional management.
- **Risks:**
  1. Unintended consequences of automated learning processes.
  2. Application of inappropriate theories.
  3. Algorithms assigning unsuitable tasks to students.

Conclusion: NNs present great potential to enhance education, particularly by relieving educators of routine tasks. However, their implementation must be ethically guided and transparent, prioritizing the complementary role of educators and addressing identified risks to avoid negative impacts on learning.

Keywords: Artificial neural networks, higher education, learning, students, teachers.

INTRODUCTION

Artificial Neural Networks (hereinafter referred to as NNs) represent one of the most significant trends shaping modern reality. Preparing people to adapt to the increasingly rapid changes in the surrounding world requires intensive actions in the field of education and training. These actions must enable society to respond effectively and efficiently to the challenges created by NNs (Bakunova et al., 2018).

Thus, this article aims to highlight a new area of educational challenges, not only for decision-makers and researchers but also for professionals involved in education at various levels: educators, education administrators, and institutions responsible for the training and development of teaching staff.

These challenges are highly diverse in nature. The ever-accelerating digitalization, robotization of workplaces, and development of NNs are altering the demand for professions, qualifications, and skills. For this reason, it is essential to maintain key and transversal competencies that meet the needs of the younger generation and address the challenges they face (Ben-David et al., 2019). Research shows the necessity of fostering citizens who understand what NN-based technologies are and how they affect us (Bosov, 2022).
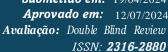
To reliably discuss these issues, it was necessary to collect relevant data, systematize it, and scientifically interpret the results.

LITERATURE REVIEW

According to researchers, the education sector can undoubtedly become a beneficiary of neural networks (NNs), but its specifics, particularly the mission of this system, should be considered at the very early stages of implementing innovative solutions (Castrillón et al., 2020). Most NN solutions are designed to generate commercial benefits for the organizations using them: NNs aim to optimize pricing strategies, logistics network routes, energy management, and more (Cazarez & Martin, 2018).

The effectiveness of NNs in many applications still depends on their ability to learn from data provided by humans or other machines, including through deep learning techniques (Chen et al., 2022). However, researchers clearly state that a universal learning algorithm that guarantees efficiency across all conditions and environments has yet to be developed (Denning & Denning, 2020).

Scientists believe that the successes and undeniable progress in NN development inspire optimism and hope, particularly regarding its potential applications in education, which are remarkably broad (Fiore, 2019). Many studies discussing the use of NNs address the idea of replacing teachers with bots that simulate human interaction (Floridi & Chiriatti, 2020, Furman & Seamans, 2019). This

is likely the ultimate stage of NN development, which will be achieved at a very late and distant point in its evolution (Kooli, 2023).

A less ambitious but more realistic goal, according to (Kazachenok, 2020), is to develop NN algorithms that simulate teacher behavior in specific, narrow areas, such as assessing student performance. Researchers note that even at the current stage of algorithm development, there are numerous educational applications for NNs that can and should be successfully utilized (Khabibullin et al., 2023). During the learning process, NNs can function as both autonomous teachers (Okuda & Shoda, 2018) and as assistants to human educators (Okewu et al., 2021).

Moreover, researchers suggest that the use of NNs in education is not limited to student-focused activities (Perrotta & Selwyn, 2020): NNs can assist teachers in identifying learning difficulties among students (Pesonen, 2021), adapting materials to individual student needs (Przegalinska et al., 2019), or simply being used for evaluation purposes (Repkina, 2016). Significant potential exists in automating tasks to free teachers from monotonous and exhausting bureaucratic responsibilities (Rincon-Flores et al., 2020).

NNs can also aid in managing lessons and the educational system, such as predicting specific trends and phenomena or student behavior in advance (Shamsutdinova, 2022). Additionally, NNs can analyze student progress in real time and provide recommendations on how to interact with individual students (Stojnić, 2015; Valko & Osadchyi, 2020).

The goal of this article is to explore the possibilities of using NNs in education and the associated risks.

METHODS

The study employed a comprehensive methodological approach combining desk research and survey methods.

In line with the research objective, an attempt was made to evaluate the advantages and disadvantages of using neural networks (NNs) and their impact on the educational process by addressing the following research questions:

1.   What are the opportunities for using NNs in higher education?

2.   What are the risks associated with the use of NNs in the educational process, particularly those stemming from the development of inappropriate machine learning algorithms?

To obtain a holistic view of current knowledge on the use of NNs in higher education, a desk research method was employed. This allowed for an analysis of scientific literature on the topic, providing a comprehensive overview of current trends and the research area of interest.

To answer the research questions, an expert survey method was applied. A sample of 44 experts was invited via email to participate in the survey. The selection criterion for the expert pool was the presence of at least three publications on the research problem in peer-reviewed journals. A total of 40 respondents agreed to participate, providing answers to the questions through email correspondence. These responses were subsequently analyzed to rank and weight the key opportunities and risks of using NNs in the educational process within higher education.

To ensure an objective analysis of the data obtained from the expert survey, the degree of consistency among expert opinions was measured using Kendall's coefficient of concordance, with mathematical processing of the results.

RESULTS

Table 1 presents a list of opportunities for using neural networks (NNs) in the educational process of higher education. To provide a more objective expert evaluation, the opportunities are grouped into the following categories:

NNs as support for the learning process,

NNs as support for educators in administrative processes,

NNs in managing the higher education system at various levels.

This categorization is important because it helps direct further research and development strategies for NNs toward solution providers. Each of the aforementioned opportunities has the potential to improve the situation for students, albeit from different perspectives.

Table 1. Opportunities for Using NNs in the Educational Process of Higher Education

Opportunities	Rank	Weight
NNs as support for the learning process		
NN as a teaching assistant	1	0.32
NN as a space ensuring emotional safety in overcoming academic failures	2	0.24
Application for individual student needs (personalization)	3	0.19
Providing feedback	4	0.16
NN as a replacement for educators	5	0.09
NNs as support for educators in administrative processes		
Student assessment	1	0.41
Methodological support	2	0.35
Monitoring student attendance and activity	3	0.24
NNs in managing the higher education system at various levels		
Analysis of large datasets in the education system	1	0.40
Data analysis at local and regional governance levels	2	0.33
Evaluation of teaching staff	3	0.27

Note: Compiled based on expert surveys; Kendall's coefficient of concordance $W=0.67$ ($p<0.01$), indicating strong agreement among expert opinions.

Table 2 outlines the risks of using NNs associated with the development of inappropriate machine learning algorithms based on neural networks.

Table 2. Risks of Using NNs

No.	Key Risks	Rank	Weight
1	Risks associated with negative side effects or unforeseen consequences of NN-driven learning processes	1	0.39
2	Risks stemming from the use of incorrect/inappropriate theories	2	0.33
3	Risks due to incorrect algorithm reasoning and assigning unsuitable tasks to students	3	0.28

Note: Compiled based on expert surveys; Kendall's coefficient of concordance $W=0.70$ ($p<0.01$), indicating strong agreement among expert opinions

CONCLUSIONS

It is expected that NNs can become an effective tool in education, freeing educators from routine tasks (such as attendance monitoring and grading), supporting their work with students, providing students with more efficient learning methods tailored to their profiles, creating a personalized learning environment, and offering comprehensive feedback. However, concerns remain that any technology introduced into higher education might ultimately diminish the role of educators and, in some cases, replace them entirely—examples of this can already be seen in other automated workplaces. Nevertheless, the role of educators will need to adapt to the environment in which students using NNs will learn. Like other technologies, NNs themselves will require educational support.

From today's perspective, NNs should primarily focus on simpler tasks. This would allow educators to dedicate more time to individualizing their approach to students. For instance, they would no longer need to adjust tests, as NNs would provide more effective feedback to students. The education system should also consider whether abandoning standardization in the learning process—a potential outcome of NN use—might have negative side effects. Therefore, NNs should prioritize fostering knowledge and skills with clear, objective benchmarks.

REFERENCES

Bakunova, O. M., Kalitenya, I. L., Bakunov, A. M., Paluyko, A. F., Antonov, E. D., & Grechko, I. S. (2018). The use of neural networks in education. *Web of Scholar*, 1(19): 8–10.

Ben-David, S., Hrubes, P., Moran, S., Shpilka, A., & Yehudayoff, A. (2019). Learnability can be undecidable. *Nature Machine Intelligence*, 7: 44–48.

Bosov, A. V. (2022). Application of self-organizing neural networks to the formation of individualized learning paths. *Informatics and Its Applications*, 16(3): 7–15.

Castrillón, O., Sarache, W., & Ruiz, S. (2020). Prediction of academic performance using artificial intelligence techniques. *From Univ*, 13: 93–102.

Cazarez, R. L. U., & Martin, C. L. (2018). Neural networks for predicting student performance in online education. *IEEE Latin America Transactions*, 16(7): 2053–2060.

Chen, X., Zou, D., Xie, H., Cheng, G., & Liu, C. (2022). Two decades of artificial intelligence in education. *Educational Technology & Society*, 25(1): 28–47.

Denning, P. J., & Denning, D. E. (2020). Dilemmas of artificial intelligence. *CACM*, 63(3): 22–24.

Fiore, U. (2019). Neural networks in the educational sector: Challenges and opportunities. *Balkan Region Conference on Engineering and Business Education*, 1: 332–337.

Floridi, L., & Chiriatti, M. (2020). GPT-3: Its nature, scope, limits, and consequences. *Minds and Machines*, 30(4): 681–694.

Furman, J., & Seamans, R. (2019). AI and the economy. *Innovation Policy and the Economy*, 19: 161–191.

Kooli, C. (2023). Chatbots in education and research: A critical examination of ethical implications and solutions. *Sustainability*, 15(7): 5614. https://doi.org/10.3390/su15075614

Kazachenok, V. V. (2020). Application of neural networks in education. *Informatics and Education*, 2(311): 41–47.

Relações Internacionais do Mundo Atual – unicuritiba

Khabibullin, I. R., Azovtseva, O. V., & Gareev, A. D. (2023). Relevance of neural networks in educational purposes. *Young Scientist*, 13(460): 176–178.

Okuda, T., & Shoda, S. (2018). AI-based chatbot service for financial industry. *Fujitsu Scientific and Technical Journal*, 54(2): 4–8.

Okewu, E., Adewole, P., Misra, S., Maskeliunas, R., & Damasevicius, R. (2021). Artificial neural networks for educational data mining in higher education: A systematic literature review. *Applied Artificial Intelligence*, 35(13): 983–1021.

Perrotta, C., & Selwyn, N. (2020). Deep learning goes to school: Toward a relational understanding of AI in education. *Learning, Media and Technology*, 45: 251–269.

Pesonen, J. A. (2021). 'Are you OK?' Students' trust in a chatbot providing support opportunities. In *Learning and Collaboration Technologies: Games and Virtual Environments for Learning: 8th International Conference* (pp. 199–215).

Przegalinska, A., Ciechanowski, L., Stroz, A., Gloor, P., & Mazurek, G. (2019). In bot we trust: A new methodology of chatbot performance measures. *Business Horizons*, 62(6): 785–797.

Repkina, N. G. (2016). Prediction of educational success for technical students using artificial neural networks. *Almanac of World Science*, 5-1(8): 92–95.

Rincon-Flores, E. G., López-Camacho, E., Mena, J., & López, O. O. (2020). Predicting academic performance with artificial intelligence (AI), a new tool for teachers and students. In *2020 IEEE Global Engineering Education Conference (EDUCON)* (pp. 1049–1054). Porto, Portugal.

Shamsutdinova, T. M. (2022). Problems and prospects of using neural networks in education. *Open Education*, 26(6): 4–10.

Stojnić, A. (2015). Digital anthropomorphism: Performers, avatars, and chat-bots. *Performance Research*, 20(2): 70–77.

Valko, N., & Osadchyi, V. (2020). Education individualization by means of artificial neural networks. *The International Conference on Sustainable Futures: Environmental, Technological, Social and Economic Matters*, 10021. https://doi.org/10.1051/e3sconf/202016610021