Development of virtual learning systems based on artificial intelligence: International experience

Vývoj virtuálních výukových systémů založených na umělé inteligenci: Mezinárodní zkušenosti

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Abstract

The aim of the article is to study and improve the use of artificial intelligence in education by analysing international experience. The main methods used were general scientific methods, documentary analysis, standard statistics, and factor analysis. The study's main results demonstrate the rapid growth in the popularity of artificial intelligence in virtual learning systems in all the countries under consideration. The article reveals a tendency to increase the demand for these technologies. The study concludes that AI has an important role in the educational process and that future research should focus on evaluating its effectiveness in training specific specialists.

Keywords: education, innovative learning, students, development, university.

Abstraktní

Cílem článku je prostudovat a zlepšit využití umělé inteligence ve vzdělávání pomocí analýzy mezinárodních zkušeností. Hlavními používanými metodami byly obecné vědecké metody, dokumentární analýza, standardní statistika a faktorová analýza. Hlavní výsledky studie ukazují rychlý růst popularity umělé inteligence ve virtuálních výukových systémech ve všech sledovaných zemích. Článek odhaluje tendenci zvyšovat poptávku po těchto technologiích. Studie dochází k závěru, že umělá inteligence hraje důležitou roli ve vzdělávacím procesu a že budoucí výzkum by se měl zaměřit na hodnocení její účinnosti při školení konkrétních specialistů.

Klíčová slova: vzdělávání, inovativní učení, studenti, rozvoj, univerzita.

Introduction

Artificial intelligence (AI) has changed how we perceive technology and its capabilities in various areas of life. According to a UNESCO policy brief, using AI in education will "reduce the time spent preparing for classes, develop creative and innovative methods to improve the level of knowledge acquisition and select individual educational trajectories for students" (Duggan, 2020).

The study aims to understand and improve AI-based learning systems by analysing international experience.

Based on the goal, the following tasks can be identified:

1. Study the dynamics of demand for virtual learning systems based on AI.

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2. Study of the development of virtual learning systems based on AI in 2022.

The object of research is innovative virtual learning systems based on AI, considering international experience in this field.

The article includes an introduction and a literature review covering the latest research. The Methodology section will provide details of the procedure and methods, while the Results and Discussion will provide an understanding of what the study's findings are based on.

The main focus of the research is to study best practices, trends and innovations in the use of AI in educational systems. By analysing experiences globally to design virtual learning systems that address modern educational needs and leverage best practices in AI.

Literature review

The study by Salas-Pilco & Yang (2022) systematically examines the use of artificial intelligence in Latin American educational institutions using a meta-analysis of various implementation cases. They found significant interest in using AI to support educational processes but emphasized the existing infrastructure and access to resources that hinder widespread adoption. This study also points to a lack of empirical data on the impact of AI on educational outcomes, emphasizing the need for further research in this area.

On the other hand, Rios-Campos et al. (2023) explore the challenges and prospects of using AI in South Florida educational institutions, with a focus on the potential for personalizing learning and improving pedagogical methods. They identify key barriers, such as high cost, ethical issues, and data privacy concerns, that require strategies to be developed for effective AI adoption.

Chen, Chen & Lin (2020) emphasize the rapid development of AI and its potential to improve virtual learning systems. They point out that new machine learning and natural language processing algorithms allow for the creation of intelligent, personalized, and effective educational systems.
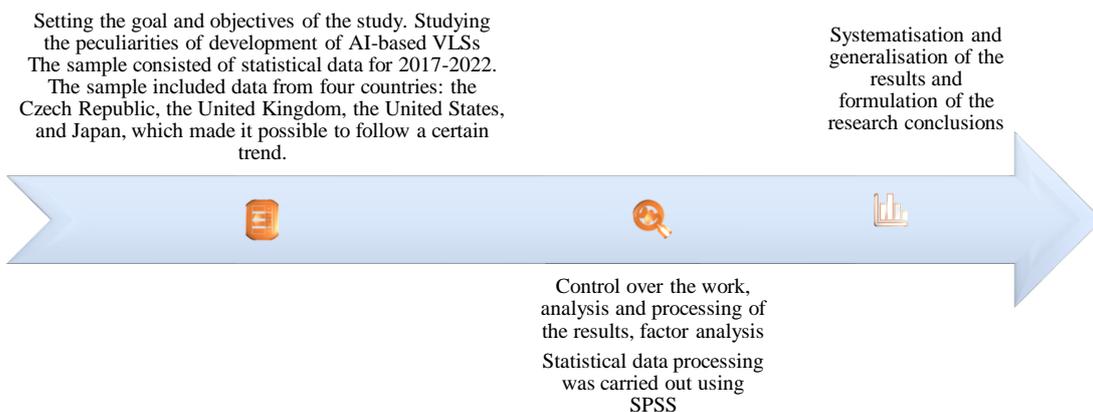
The experience of the HUSPOL Academy's teachers demonstrates the ability of AI to solve numerous problems in education, ensuring the creation of personalized curricula that take into account the needs and abilities of each student. According to HolonIQ (2022), this approach makes learning more effective and aligns with students' personal goals.

Alam (2022) emphasizes the use of intelligent analytical tools to assess student performance, identify their strengths and weaknesses, and provide recommendations for improving the learning process. This helps automate administrative tasks such as course registration and grading, freeing up staff time to work more effectively with students.

The identified trends include a growing interest in integrating AI into educational processes to personalize learning, optimize administrative tasks, and improve teaching efficiency. However, current gaps, such as limited research on the impact of AI on educational outcomes, ethical and privacy concerns, and infrastructure and access issues, require additional attention. The need for this research stems from the need to understand how AI can be effectively integrated into curricula while addressing these challenges. This includes developing strategies to overcome existing barriers and exploit the potential of AI to improve educational practices.

Methodology

The study was conducted in several stages. The stages are shown in Figure 1. The study was based on the following sources: Research and Markets (2022), HolonIQ (2022), European Commission (2022), and the OECD (2023). These sources made it possible to analyse the problem under consideration in the dynamics of its development and draw conclusions. The study uses general scientific research methods: analysis, synthesis, and documentary analysis. Standard statistics and factor analysis were used. The Alpha-Cronbach reliability coefficient was used to examine the internal consistency of the data obtained. Tools such as Microsoft Excel and Google Sheets were used for statistical calculations. All the results and conclusions obtained meet the requirements of academic integrity, validity, and reliability. The study's authors did not receive funding from stakeholders or declare any conflict of interest.

Setting the goal and objectives of the study. Studying the peculiarities of development of AI-based VLSs The sample consisted of statistical data for 2017-2022. The sample included data from four countries: the Czech Republic, the United Kingdom, the United States, and Japan, which made it possible to follow a certain trend.

Systematisation and generalisation of the results and formulation of the research conclusions

Control over the work, analysis and processing of the results, factor analysis

Statistical data processing was carried out using SPSS

Figure 1. Stages of the study.

Results

At the beginning of the study, we should pay attention to the dynamics of demand for AI-based VLSs in the Czech Republic, the UK, the US, and Japan by the number of users. The results of the study are presented in Table 1.

Table 1.
Dynamics of demand for virtual learning systems based on artificial intelligence (2017-2022) in users

Country	2017	2018	2019	2020	2021	2022	Forecast for 2023
Czech Republic	10 K	20 K	30 K	50 K	75 K	100 K	150 K
United Kingdom	100 K	200 K	300 K	400 K	600 K	500 K	750 K
USA	1 mln	2 mln	3 mln	5 mln	7 mln	10 mln	15 mln
Japan	100 K	200 K	300 K	400 K	600 K	1 mln	1.5 mln

Source: Developed based on sources: Research and Markets (2022), HolonIQ (2022), European Commission (2022) and OECD (2023)

Table 1 shows that the demand for VLSs grew significantly between 2017 and 2022 in all the countries considered. The trend is clear: demand is growing. In all countries, there has been a steady and significant increase in users during the period under review.

Next, we should pay attention to the development of AI-based VLSs by considering such indicators as the number of users, investments, number of startups, and the most common areas of use. The research results are presented in Table 2.

Table 2.
Development of virtual learning systems based on artificial intelligence in 2022

Country	Number of users	Investments	Number of startups
Czech Republic	100 000	€10 mln	20
United Kingdom	500 000	£50 mln	50
USA	Ten mln	$1 bln	100
Japan	1 mln	¥10 bln	30

Source: Developed based on sources: Research and Markets (2022), HolonIQ (2022), European Commission (2022) and OECD (2023)

The analytical Table 2 shows that in 2022, we can observe a general trend towards a significant development of VLSs in all the countries under consideration. Each has a substantial number of users and significant investments in this area. There is an active development of startups working in virtual learning. Table 3 shows the results of the factor analysis.

Table 3.

Factor analysis of the development of virtual learning systems based on artificial intelligence (2017-2022)

Factor	Impact on development	Quantification	Dynamics	Country
Investments	Increased investment stimulates the development of new systems and technologies	€1 million -> €10 million (Czech Republic)		
Number of startups	The growth in the number of startups indicates	5 -> 20 (Czech Republic)	Growth	All countries
Research and development	New research and development improves existing systems	Growth of publications		
Internet accessibility	Increasing accessibility of the Internet raises potential audience	70% -> 85% (Czech Republic)		

Source: Developed based on sources: Research and Markets (2022), HolonIQ (2022), European Commission (2022) and OECD (2023)

Table 3 provides an overview of the factors influencing the development of AI-based virtual learning systems from 2017 to 2022. It highlights the factors driving this process, including investment, the number of startups, research and development, internet availability, demand for online learning, government support, and competition. It also points to challenges that could slow the process, such as legal and ethical issues.

Learning systems based on artificial intelligence show prospects for increasing learning effectiveness, personalising the learning process and engaging students. However, problematic technical aspects, data confidentiality, and access to technologies were identified.

Discussion

The study showed that the Czech Republic, as one of the countries under study, shows a significant increase in investment, the number of startups, internet accessibility, and demand for online learning. As the survey by Kabudi, Pappas and Olsen (2021) highlights, AI is now essential in education. The authors emphasise that it opens up new opportunities for personalising learning, helping everyone develop at their own pace and according to their needs and abilities. As Mastan, Sensuse, Suryono & Kautsarina (2022) highlight, AI creates innovative teaching methods that ensure more effective learning. It also helps to focus on individualised guidance and support. AI also contributes to developing new assessment methods and provides access to quality education anywhere. But, as noted by Cheung, Kwok, Phusavat & Yang (2021), AI can become a factor of abuse and academic dishonesty if not used correctly.

The practical significance of the article lies in studying and analysing the factors that influence the development of AI-based VLSs. The theoretical relevance lies in expanding scientific knowledge about the use of AI in education. Limitations of the study include the limited number of countries studied or the limited data and methodologies used.

Conclusions

The study analysed the development of AI-based VLSs and their international application experience. The results showed a stable and significant increase in the popularity and demand for such systems in all the countries under consideration. Investment, the number of startups, research and development, internet accessibility, demand for online learning, government support and competition have been vital factors influencing this development.

Recommendations

Recommendations for the future use of AI in education include the development of ethical standards, ensuring accessibility and continuous improvement of systems. Future research should focus on developing a general methodology for training teaching staff to use AI in education.

Bibliographic references

Alam, A. (2022). Employing adaptive learning and intelligent tutoring robots for virtual classrooms and smart campuses: Reforming education in the age of artificial intelligence. In: R. N. Shaw, S. Das, V. Piuri, & M. Bianchini (Eds.), *Advanced Computing and Intelligent Technologies* (pp. 395-406). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-2980-9_32

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access*, *8*, 75264-75278.

https://doi.org/10.1109/ACCESS.2020.2988510

Cheung, S. K., Kwok, L. F., Phusavat, K., & Yang, H. H. (2021). Shaping the future learning environments with smart elements: Challenges and opportunities. *International Journal of Educational Technology in Higher Education*, *18*, 1-9. https://doi.org/10.1186/s41239-021-00254-1

Duggan, S. (2020). *AI in education: Change at the speed of learning*. UNESCO IITE. Retrieved from https://acortar.link/avqpNf

European Commission. (2022). *The Commission publishes guidelines to help teachers address misconceptions about Artificial Intelligence and promote its ethical use*. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6338

HolonIQ. (2022). *2022 Global Education Outlook*. Retrieved from https://acortar.link/N6aZiP

Kabudi, T., Pappas, I., & Olsen, D. H. (2021). AI-enabled adaptive learning systems: A systematic mapping of the literature. *Computers and Education: Artificial Intelligence*, *2*, 100017. https://doi.org/10.1016/j.caeai.2021.100017

Mastan, I. A., Sensuse, D. I., Suryono, R. R., & Kautsarina, K. (2022). Evaluation of distance learning system (e-learning): A systematic literature review. *Technoinfo Journal*, *16*(1), 132-137. Retrieved from https://ejurnal.teknokrat.ac.id/index.php/teknoinfo/article/view/1736

OECD. (2023). *OECD Future of Education and Skills 2030*. Retrieved from https://www.oecd.org/education/2030-project/

Research and Markets. (2022). *Global AI in education market size, share & industry trends analysis report by component (solution and services), by application, by end-use, by deployment mode (cloud and on-premise), by technology, by regional outlook and forecast, 2022 - 2028*. Retrieved from https://acortar.link/7qMsn6

Rios-Campos, C., Cánova, E. S. M., Zaquinaula, I. R. A., Zaquinaula, H. E. A., Vargas, D. J. C., Peña, W. S., Idrogo, C. E. T., & Arteaga, R. M. Y. (2023). Artificial Intelligence and education. *South Florida Journal of Development*, *4*(2), 641-655. https://doi.org/10.46932/sfjdv4n2-001

Salas-Pilco, S. Z., & Yang, Y. (2022). Artificial intelligence applications in Latin American higher education: A systematic review. *International Journal of Educational Technology in Higher Education, 19*(1), 21. https://doi.org/10.1186/s41239-022-00326-w