



REVIEW ARTICLE



Implementing of Artificial Intelligence in a Higher Educational Ecosystem



Authors' Contribution:

- A – Study design;
- B – Data collection;
- D – Data interpretation;
- E – Manuscript preparation;
- F – Literature search

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Abstract

The use of artificial intelligence (AI) by students and teachers in higher education is becoming increasingly common. AI implementing in higher education started as a spontaneous process among all stakeholders. Strategies and models of implementation in higher education systems must now justify this.

The aim of the study: to explore the benefits and challenges of using AI in academic university teaching, and to develop and justify a model for the optimal implementation of AI for the development of the higher education ecosystem.

Material and Methods:

The present study used several theoretical methods: analysis, synthesis, comparison, generalisation, systematisation, and classification to define the benefits and challenges of AI use by stakeholders; systems approach, modelling, and optimisation methods to develop a model for the optimal implementation of AI in a higher educational ecosystem.

Results:

The prospects of AI implementation for developing the higher education ecosystem are considered. The advantages and problems of using AI in academic university teaching are characterised based on the classification of directions of using AI in higher education. The model of optimal implementation of AI in the educational ecosystem of higher education, based on the systems approach, has been developed and substantiated. This model include structural (universities, faculties, departments, institutes, centres, doctoral schools, clinics, and labs) and functional (internal – content of education, forms and methods of teaching, diagnosing of learning outcomes, administering of educational service, and eternal – include academic achievement: levels of knowledge, skills, and competences) components.

Conclusions:

The study highlights the importance of implementing AI in higher education, as well as the need for collaboration between all university stakeholders in the digitisation of education. The results are essential for developing university strategies for developing educational ecosystem The curriculum should be relevant, meeting the interests of students and the current needs of employers. Education stakeholders are encouraged to use the available benefits of AI responsibly to address the challenges of student learning and teacher organisation in universities.

Keywords:

artificial intelligence, higher education, Human-AI System, educational ecosystem, benefits and challenges of artificial intelligence, stakeholders in higher education

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Introduction

Artificial intelligence technologies are becoming increasingly embedded in people's daily lives. A new system of relationships is emerging, the "Human-AI System" (Melynk & Pypenko, 2023), which opens up prospects for further study and use of artificial intelligence (AI) in almost all areas of human activity. Education plays an important role in building sustainable development.

The interest of higher education in AI has increased significantly after the emergence of ChatGPT based on artificial intelligence. The accessibility and simplicity of this chatbot has made it extremely popular with all stakeholders in higher education (Baidoo-Anu & Ansah, 2023; Bonsu & Baffour-Koduah, 2023; Melynk & Pypenko, 2024). However, this article is not limited to examining the use of ChatGPT in higher education. It focuses on exploring the issue more broadly.

When we use the term AI in our study, we mean computer systems, various AI technologies and applications, intelligent learning systems, chatbots, robotic and automated assessment systems that support and enhance education.

The article focuses on the benefits and challenges of using AI stakeholders in education. Special attention is paid to the model of optimal implementation of AI for building an educational ecosystem of higher education.

The aim of the study. To explore the issues of benefits and challenges of using AI in academic university teaching, and to develop and justify a model of optimal implementation of AI for the development of the educational ecosystem of higher education.

Materials and Methods

A number of theoretical methods were used in the present study: analysis, synthesis, comparison, generalisation, systematization, classification to define the benefits and challenges of AI use by stakeholders; systems approach, modelling and optimisation methods to develop a model for the optimal implementation of AI in a higher educational ecosystem.

In the present study, we used internet resources to search for information based on the main concepts of AI in education, and analysed previous studies and reviews of periodicals. Studies published in scientific journals in a given field covered the following scientometric bases: Google Scholar. Education Resources Information Center (ERIC), Social Science Citation Index (SSCI), MDPI.

For the review, we selected English-language research studies on the use of AI in higher education that were published within the last 5 years in reputable scientific peer-reviewed journals from Web of Science and Scopus.

We used a search string that specified such selection criteria: "artificial intelligence", "higher education", "students and teachers", "diagnostic purposes", "assessing students", "providing feedback", "learning analytics", "special educational needs", "legitimacy of using AI-based Chatbots".

Results and Discussion

Higher education is an open social system closely linked to advanced scientific research. Over the past five years, higher education has been greatly enriched by new AI technologies.

AI can have a number of applications in education: for assessing students (González-Calatayud et al., 2021; Hooda et al., 2022; Smerdon, 2024), for diagnostic purposes (Gupta et al., 2021), for providing feedback to students and teachers (Nazaretsky et al., 2024; Guo et al., 2024; Banihashem et al., 2024), thus ensuring continuous formative evaluation (Darvishi et al., 2022; Escalante et al., 2023).

Numerous studies show that AI can be used for personalised learning (Pratama et al., 2023; Kolchenko, 2018; Sajja et al., 2024), for gaming and active learning (Alam, 2022; Fachada et al., 2023; Kanja & Paschal, 2023).

Researchers believe that AI could also be used for students with special educational needs (Hopcan et al., 2023; Sharma et al., 2023; Chalkiadakis et al., 2024).

Studies have been conducted to investigate the use of AI for language learning by students (Divekar et al., 2022; Li, 2024; Han, 2024). This opens up the possibility of using AI to help international students overcome difficulties and facilitate their integration into different educational and cultural environments (Ma et al., 2024; Bannister et al., 2024; Wang, T., et al., 2023).

The use of AI for learning analytics (Ouyang et al., 2024; Ouyang et al., 2023; Salas-Pilco et al., 2022) and learning management (Ahmad et al., 2022; Dai et al., 2024; Chen et al., 2020) was also explored.

Thus, the education system is constantly enriched with new advanced technologies and methodological approaches, and innovative forms and methods of teaching are regularly introduced. This contributes both to the improvement (professional development) of teachers and to the involvement of students in the learning process, activating their cognitive processes and motivating their development. In addition, it provides employers with an influx of young, information technology-savvy professionals.

Among the new information technologies, it is worth mentioning those that open up fundamentally new possibilities: blockchain technology and artificial intelligence technologies.

Studies have described the benefits of implementing blockchain technology in various sectors, including higher education. According to the authors (Bhaskar et al., 2021; Pypenko & Melynk, 2020; Raimundo et al., 2021), blockchain technology can be implemented in various areas of education to improve efficiency, effectiveness, privacy controls and technological enhancements. This is in line with today's requirements for the training of young professionals in universities.

Furthermore, according to Melynk and Pypenko (2020), blockchain technology will facilitate the transition of education to a new, higher quality level. In the process of education, digital identifications are used. The whole education chain of those who study is systematised (school – university – production). All acts are realised



in the consecutive order and agreed upon. The freedom of choice as for the goal, content, forms and methods of studying is considered. There is a possibility to choose a teacher/lecturer and the appropriate time for studying. The authors (Melnyk & Pypenko, 2020) believe that this modern technology will help people's nature. It will make the educational process easy, useful and interesting.

However, some researchers (Loukil, et al., 2021) note that despite the positive aspects of blockchain, several concerns continue to undermine its adoption in education, such as legal, immutability and scalability issues.

Next, let us take a look at artificial intelligence technology. Like blockchain technology, it has advantages and some disadvantages.

One of the most obvious, and recognised by many researchers, problems with introducing AI into higher education is the issue of the ethics and legality of AI.

A number of studies have highlighted the need for ethical considerations and guidelines for the implementation of AI. A meta-review by Bond et al. (2024) identified research gaps that point to the need for greater ethical, methodological and contextual considerations in future research, as well as interdisciplinary approaches to the application of AI in higher education. Pisica et al. (2023) point to the need to control AI technologies in terms of careful monitoring, regulation and legislation to avoid ethical violations, privacy dilemmas and bias, and to adapt higher education stakeholders to new technologies and methods.

Next in importance, in our view, is the question of the right and legitimacy of using various AI technologies and applications, chatbots, in higher education.

The studies describe the challenges and benefits of implementing chatbots in higher education. Researchers (Abulibdeh et al., 2024) believe that in addition to ethical issues, AI-based chatbots such as ChatGPT will need to address curriculum revisions, continuous learning strategies and compliance with industry standards.

A study by Baidoo-Anu and Ansah (2023) note that among other benefits of ChatGPT, the chatbot promotes personalised and interactive learning, creates prompts for formative assessment activities that provide continuous feedback to inform teaching and learning, etc. This study highlights some inherent limitations of ChatGPT: creation of false information, data training bias, privacy issues, etc. This has been confirmed by other studies (Rasul et al., 2023) which investigated the benefits of the generative AI model, ChatGPT, in higher education and highlighted the following: the potential to facilitate adaptive learning, provide personalised feedback, support research and data analysis, provide automated administrative services, and help develop innovative assessments. Among the problems cited are concerns about academic integrity, reliability issues, inability to assess and reinforce graduate skills, limitations in assessing learning outcomes, and potential biases and distortions in information processing.

A solution to the problem of AI usability that stakeholders in higher education may face is seen by some researchers through the use of AI licensing, which is an important legal tool (Malgier & Pasquale, 2024). Licensing should be used in many high-risk areas of AI. They believe that ex-ante licensing of large-scale use of AI should become commonplace in jurisdictions committed to enabling democratic governance of AI.

Exploring the legitimacy of using AI-based chatbots in scientific research, Melnyk and Pypenko (2023) proposed a new method for indicating the involvement of AI and the role of chatbots in a scientific publication. Melnyk and Pypenko (2023) have developed a basic logo that can be used to indicate chatbot participation and contribution to publications. The authors have designed and implemented an information technology platform, AIC AI Chatbots, for practical applications. (<https://doi.org/10.26697/ai.chatbots>). It provides technological solutions related to using AI-based chatbots (text, image, and video) in scientific research and publishing.

When considering the issue of law, legitimacy and the use of attribution for AI, it is also useful to consider the protection of the rights of the individual who creates or performs work without AI. A study by Pypenko (2023) proposed attribution of a product created by humans without AI involvement. The author (Pypenko, 2023) believes that this helps to protect the human right to work and to increase the value of natural human labour. Perhaps one of the most significant challenges slowing down the effective integration of AI in higher education is the profit orientation of app developers (Luckin & Cukurova, 2019). Developers rarely have the pedagogical background and didactic knowledge required to create a quality educational product.

As mentioned above, there have been many studies in recent years that have examined the use of AI in higher education. In many of them, the authors pointed to both benefits and problems for stakeholders. The impact of distance learning and trends in using AI-based chatbots in higher education among stakeholders were explored (Aleedy et al., 2022; Al-Sharafi et al., 2023; Pypenko et al., 2020). These studies suggest that blended learning and the use of AI chatbots in higher education can be effectively used to assist students with their academic matters, progress monitoring, academic advice and administrative matters during their studies.

Others, such as Wang S. et al (2023), argue that AI can enhance learning and provide personalised educational support. However, there are risks and limitations: confidentiality issues, cultural differences, linguistic competence and ethical implications.

Among other challenges to the use of AI in higher education, researchers highlight the following: privacy concerns, security and bias (Al-Zahrani & Alasmari, 2024); reliance on technology, lack of human touch, risk of cheating, displacement of teacher jobs (Clugston, 2024); lack of technology skills among students and teachers, and lack of applicability in different contexts, limited reliability (Celik et al., 2022; Crompton et al., 2022).



Among the advantages of using AI in higher education, researchers highlight the following:

- improving planning, implementation of immediate feedback and evaluation (Celik et al., 2022);
- minimising the administrative tasks of the educator, assisting with different types of tasks in the form of learning analytics, virtual reality and minimising the workload of the teacher, effective and easy assessment of students (Ahmad et al., 2022);
- facilitation of learning, personalised approach and feedback; effectiveness of AI tools and applications such as virtual and augmented reality, voice assistants, translation tools, chatbots, gamification, learning and tutoring programmes, instant assessment, etc. (Pisica et al., 2023);
- personalised learning, immersive learning experiences, improved student engagement and motivation, cost-effective learning, integrated learning and intelligent tutoring system, continuous evaluation and improvement over time, raising academic standards and quality of education (Clugston, 2024).

Pypenko (2024) proposed classifying the directions of implementing AI in higher education:

1. Content of education (e.g. development of training programmes, courses, topics).
2. Forms and methods of teaching (e.g. personalisation of learning and tutoring; a wide range of verbal, visual,

gaming and other learning methods; innovative technologies such as virtual reality and augmented reality; translation tools; chatbots).

3. Diagnosing of learning outcomes (e.g. use of testing, quizzes, ease of student assessment, provision of continuous feedback).

4. Administering of educational services (e.g. developing competitive education strategies, optimising learning planning, data analysis, planning, record keeping, course selection, credit counting, using chatbots for marketing).

Undoubtedly, the described classification allows researchers studying the possibilities of AI implementation in higher education to systematise the advantages and problems of using AI in educational environment.

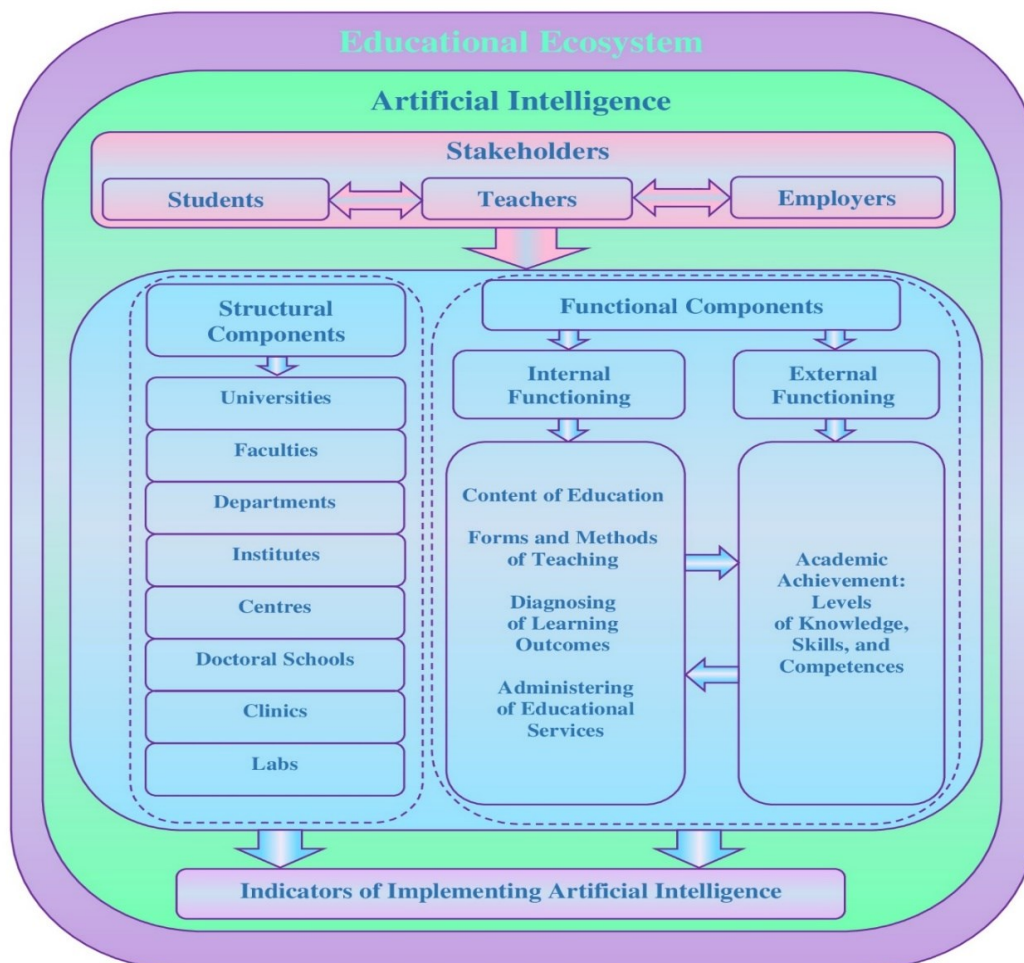
In our opinion, the methodology of the systems approach to the implementation of the above-mentioned AI directions in higher education will be the most optimal solution.

This allows each component of the system to operate both at a sub-system level and in conjunction with others to achieve maximum efficiency.

This concept required us to develop a model for the optimal implementation of AI in the higher education ecosystem (Figure 1).

Figure 1

Model for the Optimal Implementation of Artificial Intelligence in a Higher Educational Ecosystem





The systemic approach to substantiate the model of optimal implementation of AI in the educational ecosystem of a higher school allowed us to identify the following 3 parameters: stakeholders, components of the educational ecosystem of a higher school, indicators of implementing artificial intelligence.

We have identified the following stakeholders of higher education: students, teachers, employers.

Using the systems approach methodology to substantiate this model allowed us to identify structural and functional components.

Structural components include universities, faculties, departments, institutes, centres, doctoral schools, clinics, labs.

Functional components are divided into two groups: internal functioning components and external functioning components.

Internal functioning components include content of education; forms and methods of learning; diagnosing of learning outcomes; administering of educational services.

Eternal functioning components include academic achievement: levels of knowledge, skills, and competences.

Indicators of the implementation of artificial intelligence make it possible to determine the level of effectiveness of the implementation of this model in practice.

Conclusions

There is growing concern about the ethical and legal implications of using AI in higher education systems. Educational stakeholders are encouraged to use the available benefits of AI responsibly and effectively to meet the challenges of student learning in higher education, taking into account the ethical and legal implications of its use. Addressing these challenges and regularly improving digital literacy in higher education will contribute to the development of advanced educational ecosystems.

University administrators should consider both the social demand from students and their own capacity to implement AI to deliver innovative study programmes. These programmes should be relevant and meet the current needs of employers. It is also important to pay attention to building the capacity of higher education stakeholders for the intensive AI development process in the near future.

Ethical Approval

The study protocol was consistent with the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a prior approval by the Institution's Human Research Committee. Research permission was granted by the Committee on Ethics and Research Integrity of the Scientific Research Institute KRPOCH (protocol no. 025-1/SRIKRPOCH dated 10.08.2024).

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