

Model of application of artificial intelligence in higher education based on interaction between user and computer system

Zoran G. Pavlović^{1*}, Ana Savić², Veljko Radičević¹, Rade Vasiljević¹

¹ ATAAS, Departments School of Railroad Transport, Belgrade, Serbia

² ATAAS, Department of Electrical Engineering and Computer Science, Belgrade, Serbia

ARTICLE INFO

* Correspondence: zoran.pavlovic@vzs.edu.rs

DOI: <https://doi.org/10.46793/ET26.D09P>

PAGES: D75 – D80

ABSTRACT

Modern higher education is increasingly dependent on digital technologies, large scientific databases, and intelligent information systems. Researchers and academic staff face the challenge of processing large volumes of information in a short period of time. Traditional approaches to searching scientific literature and analyzing research data often require significant time and effort. The rapid development of Artificial Intelligence (AI), especially generative AI systems such as ChatGPT and Gemini, has enabled a new approach to research and education. This paper presents a model of AI application in higher education based on the interaction between users and computer systems. The proposed model includes the transformation of traditional educational and research processes into digital processes supported by intelligent algorithms. The paper analyzes the role of AI systems in scientific research, digital learning, and academic communication. Particular attention is given to the advantages, limitations, and future perspectives of AI implementation in higher education institutions. The results indicate that AI platforms can significantly improve research efficiency, access to information, and the quality of education, while also requiring adequate digital competencies and ethical standards.

KEYWORDS

Artificial Intelligence, higher education, digital transformation, research, ChatGPT, interaction

1. INTRODUCTION

Digital transformation has become one of the most important development directions in higher education institutions worldwide. Universities and research institutions increasingly rely on digital technologies, online databases, cloud computing, and artificial intelligence systems to improve research and educational processes [1].

In recent years, generative AI systems have attracted considerable attention due to their ability to generate text, analyze data, process natural language, and support decision-making processes. Platforms such as ChatGPT, Gemini, Claude, and Microsoft Copilot are increasingly used in education and scientific research [2]. Currently, the most prominent platforms of table 1.

The application of AI systems in higher education enables researchers to process large amounts of information more efficiently and improve the quality of scientific work. However, the implementation of AI technologies also raises ethical and methodological issues related to academic integrity, data protection, and the reliability of generated information [3].

The aim of this paper is to present a model of AI application in higher education based on interaction between users and computer systems, with a focus on digital transformation and research efficiency.

Table 1: Overview of Modern AI Platforms

AI Platform	Company	Main Function	Application in Education and Research
ChatGPT	OpenAI	Natural language processing	Writing assistance, research support, content generation
Gemini	Google	Multimodal AI system	Data analysis, academic search, educational support
Claude	Anthropic	AI-based text analysis	Scientific writing and document processing

Microsoft Copilot	Microsoft	AI integration in Office tools	Administrative automation and analytics
Perplexity AI	Perplexity	Intelligent web search	Literature review and source identification
Elicit	Ought	Research assistant	Scientific paper analysis and references
Scite Copilot	Scite Inc	Citation analysis	Evaluation of scientific literature

The roles of people (students, teachers, researchers) are increasingly taking place through computer systems and advanced internet technologies. Every interaction with such a system can be considered the realization of a business process. In business processes, human activities are less and less represented. The realization of the needs of users, as well as employees in companies, can be achieved through the application of computer systems. The dimensions of context and situational parameters in communication processes are presented. Business modalities include traditional methods that are still used, the application of autonomous intelligent agents and the application of generative artificial intelligence agents that are currently occupying the academic community and increasingly business companies and organizations. The main goal includes the presentation of the advantages of the application of innovative digital technologies and the transformation that is inevitable. The semantic dimensions of the context with factors of communication dynamics are presented, where the advantages of the application from traditional to generative artificial intelligence agents are clearly visible [4].

2. ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION

Artificial Intelligence represents a branch of computer science focused on developing systems capable of performing tasks that normally require human intelligence. Modern AI systems are based on machine learning, deep learning, and natural language processing technologies [5]. AI technologies have become an essential component of modern educational systems. Their application includes:

- intelligent tutoring systems;
- personalized learning;
- automated evaluation systems;
- scientific research support;
- virtual learning environments;
- predictive analytics.

According to UNESCO reports, AI has the potential to significantly improve accessibility and quality of education through adaptive and personalized learning approaches [6].

One of the most important developments in recent years is the emergence of generative AI systems. These systems are capable of generating human-like text, summarizing documents, translating languages, and answering complex questions. In higher education, generative AI can support both teachers and students by automating routine activities and enabling faster access to information [7].

AI systems are particularly useful in scientific research because they can analyze large databases and identify relevant scientific references in a very short time. This capability is especially important for researchers dealing with multidisciplinary studies and rapidly evolving scientific fields.

Despite numerous advantages, AI implementation also presents several challenges:

- reliability of generated content;
- ethical concerns regarding plagiarism;
- data privacy and security;
- algorithm transparency;
- dependence on digital technologies.

Therefore, responsible use of AI systems in education requires the establishment of ethical standards and adequate user training.

3. MODEL OF USER-COMPUTER INTERACTION

The proposed model of AI application in higher education is based on continuous interaction between users and intelligent computer systems. The model includes several interconnected components:

- User;
- AI platform;
- Database system;
- Communication interface;
- Analytical module.

The user can be a student, teacher, or researcher. Through a communication interface, the user submits requests to the AI platform using natural language. The AI system processes the request, searches databases, analyzes information, and generates an appropriate response. The interaction process consists of several phases:

- identification of the research problem;
- formulation of user requests;
- data collection and analysis;
- generation of responses;
- evaluation of results;
- implementation of acquired knowledge.

The effectiveness of the interaction largely depends on the quality of user input and the digital competencies of the user. Properly formulated prompts significantly improve the quality of generated outputs [8].

Modern AI systems support multimodal interaction, enabling the processing of text, images, audio, and video content simultaneously. Such systems provide greater flexibility and improve communication efficiency between users and computer systems.

The model also supports integration with scientific databases, learning management systems, and cloud platforms. This integration enables faster access to scientific information and improves collaboration among researchers.

4. APPLICATION OF AI PLATFORMS IN SCIENTIFIC RESEARCH

Scientific research requires extensive literature review, data processing, and analysis of research results. Traditional research methods often involve time-consuming manual activities. AI systems significantly reduce the time needed for these processes [9]. Generative AI platforms are increasingly used in various phases of scientific work:

- literature review;
- data classification;
- statistical analysis;
- scientific writing;
- language translation;
- preparation of presentations and reports.

AI systems are especially useful in identifying relevant scientific references. Intelligent search systems can analyze thousands of scientific papers and extract the most relevant information related to a specific research topic.

ChatGPT and Gemini are among the most commonly used AI tools in academic environments. Researchers use these systems for generating research ideas, summarizing scientific articles, and improving academic writing quality [10].

AI technologies also contribute to improving communication and collaboration among researchers. Cloud-based AI systems allow simultaneous access to documents, collaborative editing, and automated content generation.

However, researchers must critically evaluate AI-generated information. AI systems may generate inaccurate or biased content, especially when dealing with incomplete or outdated data. Therefore, human supervision remains essential in scientific research.

5. ADVANTAGES AND LIMITATIONS OF AI SYSTEMS

5.1. Advantages

The tremendous progress in artificial intelligence (AI) opens up new opportunities for education, with intelligent teaching systems (ITS) powered by generative artificial intelligence (GenAI) emerging as a promising prospect. Therefore, state-of-the-art approaches with the integration of large language models (LLMs) are being explored to improve programming education. We investigate whether and how GenAI-based ITSs can effectively support students in learning programming skills. We observe the performance of three current LLM-user interface pairings: GPT-3.5 via ChatGPT, PaLM 2 via Google Bard, and GPT-4 via Bing. Evaluating LLMs on four types of problem settings in learning/teaching programming. Experimental results show that the use of generative AI, especially LLMs for programming, is promising, where GPT-3.5 gave the most satisfactory results [11]. The implementation of AI systems in higher education provides numerous benefits:

- increased efficiency;
- faster information processing;
- improved accessibility of educational resources;
- automation of administrative tasks;
- support for decision-making processes;
- enhanced digital competencies.

AI systems allow researchers and teachers to focus on creative and analytical activities while routine tasks are automated. Personalized learning environments also improve student engagement and learning outcomes [12].

5.2. Limitations

Virtual digital humans generated by artificial intelligence are profoundly changing digital innovation and user ecosystems. However, the dynamic evolution of their application scenarios, inherent conceptual ambiguities, and continuous advancement of technological features can all combine to generate negative user perceptions. It is imperative to systematically examine the overall impact, inherent technological limitations, and emerging challenges associated with virtual digital humans. Using the Theory, Context, Characteristics, and Metrics (TCCM) analytical framework, the study conducts a systematic review of a large number of authoritative journal articles published up to January 2025. The results reveal the negative effects of virtual digital humans generated by artificial intelligence on users and compare the relationship between hallucinations and random apparitions. In addition, the study further explores the dimensions of assessing these negative impacts [13]. Despite many advantages, AI systems also have limitations:

- inaccurate or misleading outputs;
- ethical concerns regarding academic integrity;
- lack of transparency in AI algorithms;
- cybersecurity risks;
- dependence on digital infrastructure.

One of the major concerns is the potential misuse of AI tools for plagiarism or unauthorized content generation. Educational institutions must therefore develop clear policies and ethical guidelines regarding AI usage.

Another limitation is the digital divide between users with advanced digital skills and those with limited technological competencies. Continuous education and professional training are necessary for effective AI adoption.

6. FUTURE PERSPECTIVES OF AI IN EDUCATION

Critical thinking is a key competency in higher education, especially in digital environments that require analysis, judgment, and informed decision-making. Generative Artificial Intelligence (GenAI) presents a new opportunity to enhance complex cognitive skills in educational settings. A key question may be: What is the impact of using GenAI tools on the development of critical thinking in university students? The study concludes that the intentional integration of GenAI technologies, when aligned with clear educational goals, can have a significant and positive impact on the development of critical thinking in university contexts. These findings offer empirical support for the design of innovative, ethically grounded learning experiences that incorporate GenAI to enhance cognitive development in higher education [14].

The future development of AI technologies will significantly influence higher education systems. Future AI applications are expected to include:

- advanced intelligent tutoring systems;
- adaptive learning environments;
- automated scientific evaluation;
- virtual and augmented reality integration;
- multimodal AI communication systems.

The integration of AI with learning management systems and digital libraries will further improve educational accessibility and research efficiency. Universities will increasingly rely on AI-driven analytics to improve institutional performance and educational quality. The integration of artificial intelligence (AI) into engineering higher education is becoming increasingly important today. The study contributes to the integration by providing a comprehensive overview of current research on the integration of AI into engineering higher education and by presenting a pilot introductory AI module designed to teach engineering students the basics of AI. Background: With the rapid development of AI, it is crucial to integrate AI into engineering curricula to prepare students for the workforce. However, comprehensive research on strategies for integrating AI into engineering higher education is lacking. Research Questions: What is the current state of AI integration into engineering higher education? What are the key considerations for integrating AI education into undergraduate engineering programs? What are the challenges and lessons learned when delivering AI modules to undergraduate electronics students? [15].

With the rapid development of generative artificial intelligence (AI), it is widely used in the field of higher education, especially in ideological and political education in universities. From the perspective of responsible innovation, the impact of generative artificial intelligence (AI) in universities is discussed. It empirically analyzes the practical application and effect of generative AI in universities through questionnaires, interviews and classroom observations. The results show that the introduction of generative AI improves students' acceptance and participation in the classroom, which positively affects the teaching effect. At the same time, the research also reveals the social, environmental and ethical responsibilities that should be paid attention to during the application of generative AI. By constructing a structural equation model, it further explores the relationship between the frequency of use of generative AI, students' acceptance and the diversity of

teachers' teaching methods and teaching effect, which provides useful reference and illumination for future educational reforms and technology integration. In addition, it also discusses the challenges and limitations of the application of generative artificial intelligence in university individual education and provides appropriate suggestions for promoting its effective application and development in the field of education [16].

Another important trend is the development of ethical AI frameworks in education. International organizations and academic institutions are already working on standards for responsible AI implementation.

Future educational systems will likely combine human expertise with AI support, creating hybrid educational environments that integrate traditional and digital learning approaches.

7. CONCLUSION

Artificial Intelligence has become one of the key technologies driving digital transformation in higher education. AI systems significantly improve research efficiency, information accessibility, and educational quality.

The proposed model of interaction between users and computer systems demonstrates how AI platforms can support scientific research and educational processes. Generative AI systems such as ChatGPT and Gemini provide new opportunities for digital learning, scientific collaboration, and automated information processing.

Despite numerous advantages, successful implementation of AI technologies requires adequate digital competencies, ethical standards, and responsible usage policies. Human supervision and critical thinking remain essential components of scientific research and education.

Future development of higher education will increasingly depend on the integration of intelligent systems and digital platforms into academic activities. AI technologies will continue to transform traditional educational models and contribute to the development of innovative learning environments.

REFERENCES

1. Quy, V.K.; Thanh, B.T.; Chehri, A.; Linh, D.M.; Tuan, D.A. AI and Digital Transformation in Higher Education: Vision and Approach of a Specific University in Vietnam. *Sustainability* 2023, 15, 11093. <https://doi.org/10.3390/su151411093>.
2. Munaye, Y.Y.; Admass, W.; Belayneh, Y.; Molla, A.; Asmare, M. ChatGPT in Education: A Systematic Review on Opportunities, Challenges, and Future Directions *Algorithms*, 2025, 18, 352, <https://doi.org/10.3390/a18060352>.
3. Kun Dai, Yabing Liu, Xiaofan Zhang, Generative AI in higher education: A bibliometric review of emerging trends, power dynamics, and global research landscapes, *Computers and Education: Artificial Intelligence*, Volume 10, 2026, 100544, ISSN 2666-920X, <https://doi.org/10.1016/j.caeai.2026.100544>.
4. Pavlović, Z. ., & Savić, A. . (2025). Context of Business Transformation: From Traditional to Generative AI Agents. *E-Business Technologies Conference Proceedings*, 4(1). Retrieved from <https://ebt.rs/journals/index.php/conf-proc/article/view/266> (Original work published November 17, 2025)
5. R. S. Sutton and A. G. Barto, *Reinforcement Learning: An Introduction*, 3rd ed., MIT Press, 2024. <https://www.andrew.cmu.edu/course/10-703/textbook/BartoSutton.pdf> 2018.
6. UNESCO, *Guidance for Generative AI in Education and Research*, Paris, France, 2024. <https://school-education.ec.europa.eu/en/discover/publications/guidance-generative-ai-education-and-research>.
7. Wang, J., Fan, W. RETRACTED ARTICLE: The effect of ChatGPT on students' learning performance, learning perception, and higher-order thinking: insights from a meta-analysis. *Humanit Soc Sci Commun* 12, 621 (2025). <https://doi.org/10.1057/s41599-025-04787-y>.
8. Garzón, J.; Patiño, E.; Marulanda, C. Systematic Review of Artificial Intelligence in Education: Trends, Benefits, and Challenges. *Multimodal Technol Interact*.2025, 9, 84 <https://doi.org/10.3390/mti9080084>.
9. Greussing, E., Guenther, L., Baram-Tsabari, A., Dabran-Zivan, S., Jonas, E., Klein-Avraham, I., Taddicken, M., Agergaard, T., Beets, B., Brossard, D., Chakraborty, A., Fage-Butler, A., Huang, C.-J., Kankaria, S., Lo, Y.-Y., Middleton, L., Nielsen, K. H., Riedlinger, M. and Song, H. (2025). Exploring temporal and cross-national patterns: the use of generative AI in science-related information retrieval across seven countries *JCOM* 24(02), A05. <https://doi.org/10.22323/2.24020205>.
10. Merino-Campos, C. The Impact of Artificial Intelligence on Personalized Learning in Higher Education: A Systematic Review. *Trends Higs. Educ.*, 2025, 4, 17, <https://doi.org/10.3390/higheredu4020017>.
11. L. Frank, F. Herth, P. Stuwe, M. Klaiber, F. Gerschner and A. Theissler, "Leveraging GenAI for an Intelligent Tutoring System for R: A Quantitative Evaluation of Large Language Models," 2024 IEEE Global Engineering Education Conference (EDUCON), Kos Island, Greece, 2024, pp. 1-9, <https://doi.org/10.1109/EDUCON60312.2024.10578933>.
12. OECD, *Artificial Intelligence and the Future of Skills and Education*, OECD Publishing, Paris, 2025. <https://www.oecd.org/en/about/projects/artificial-intelligence-and-future-of-skills.html>.

13. Y. Yang, S. Li and S. Qiu, "A Systematic Literature Review on the Negative Impacts of AI-Generated Virtual Digital Humans," in IEEE Access, vol. 13, pp. 80047-80062, 2025, <https://doi.org/10.1109/ACCESS.2025.3564041>.
14. L. M. Oliva-Córdova, I. Álvarez-Icaza and C. E. George-Reyes, "Evaluation of Generative AI Use to Foster Critical Thinking in Higher Education," in IEEE Revista Iberoamericana de Tecnologías del Aprendizaje, vol. 20, pp. 237-243, 2025, <https://doi.org/10.1109/RITA.2025.3597848>.
15. Y. Hao, Y. Liu, B. Liu, G. Amarantidis and R. Ghannam, "Integrating AI in Engineering Education: A Comprehensive Review and Student-Informed Module Design for U.K. Students," in IEEE Transactions on Education, vol. 68, no. 2, pp. 173-185, April 2025, <https://doi.org/10.1109/TE.2025.3536105>.
16. Y. Xing, "The Influence of Responsible Innovation on Ideological Education in Universities Under Generative Artificial Intelligence," in IEEE Access, vol. 12, pp. 133008-133017, 2024, <https://doi.org/10.1109/ACCESS.2024.3459469>.