https://doi.org/10.53656/isct-2025.16

Transport Equipment

INNOVATIVE PLATFORMS BASED ON ARTIFICIAL INTELLIGENCE IN EDUCATIONAL AND RESEARCH INSTITUTIONS

Zoran G. Pavlović, Ana Savić
Academy of Technical and Art Applied Studies ATAAS, Belgrade, Republic of Serbia

Abstract. Employees in the academic community have an increasing need to apply large databases in their research. Large databases contain relevant references (information) which, in the methodological sense, represent the starting point for the realization of the entire research process. In the Republic of Serbia, employees in higher education institutions (Institutes, Universities, Academies of Vocational Studies and Vocational Colleges, as well as employees in the health sector have access to certain databases. The lack of relevant theoretical and practical information can undermine the existing research system. A proposed solution to the aforementioned problem can be in the application of advanced internet platforms, such as Chat GPT and Gemini. In this paper, platforms based on artificial intelligence (AI) as a generator and transformation of traditional into digital processes are presented. Where you can also see the transformation of classical education into a fully digital education, which employees in research and educational institutions can apply in their narrower fields. The main goal of this work is to gradually introduce the academic community to a new virtual platform that can further improve the existing and future knowledge of experts in the realization of various tasks. In addition to the covered AI platforms, it is necessary for the user to have the appropriate practical and theoretical knowledge in the field of his interest is an expert and can apply the data obtained by AI because it knows what is true, right or correct.

Keywords: large databases; artificial intelligence; digital platforms; electronic searches; transformation of traditional ways of learning

1. Introduction

Artificial intelligence (AI) represents one of the most significant technological revolutions of the modern era, which is implemented in all areas of business with the real needs of users. It is an interdisciplinary field that combines computer science, mathematics, statistics, linguistics, psychology and neurobiology with the aim of developing a simple autonomous system capable of imitating and improving

human intelligence in making certain decisions [1]. AI allows computers, devices, machines to learn from the available database, make certain decisions, solve potential problems, recognize patterns, communicate in natural language and even show certain forms of creativity in the form of photos and text. In this way, AI not only automates routine tasks that can be a problem for employees due to their frequency but also opens up space for innovation in almost all areas of society – from medicine and industry to finance, traffic and education.

The development of AI is taking place rapidly thanks to progress in the processing of large amounts of data (big data), the development of neural networks and algorithms for deep learning (deep learning), as well as increasingly accessible computing power [2]. These technologies are changing the way we learn, work, communicate and make decisions. In the context of education, AI has the potential to transform traditional teaching models, improve the quality of teaching, enable personalized learning and support both students and teachers.

Currently, the most appropriate and practical way of conducting classes is face-to-face, where teaching staff and students have direct communication, or in other words holding classes in the premises of an educational institution where the presence of teachers and students is mandatory. Educational institutions have their own platforms for e-learning and they contain processed teaching units, literature, notices and the like. At the time of virus pandemic, another model was applied that was based on advanced Internet technologies such as Google Classroom. It is a modem that also includes remote learning that is accredited at certain educational institutions. It does not imply the physical presence of students and teachers, but an internet connection on computer devices is required.

Today, when advanced Internet technologies are increasingly prevalent [3], in various researches of the author, new knowledge can be acquired that can be applied in future researches [4, 5, 6, 7]. This paper presents a model of AI application in educational and research institutions, where it should be noted that AI without user knowledge cannot help a lot in making a decision on solving a task.

2. Related literature

The application of AI in education and science is shown in individual works that have been selected so that readers and future users (students, teachers and researchers) adopt the Chat GPT and Gemini platforms as clearly as possible.

The study assesses the validity of large language models (LLMs) as conversational artificial tutors for computer science learning. While the current literature on engineering education has largely emphasized the rapid evolution of LLMs as conversational artificial tutors for programming languages, research on their effectiveness within general STEM topics remains relatively scarce. The current study therefore focuses on assessing the potential of LLMs to facilitate understanding of fundamental hardware design concepts crucial for computer science

and engineering (CSE) education. By cross-validating the responses of generative chat bots for artificial engineering informatics to an open-ended CSE-based question, we aimed to discover how LLMs, such as ChatGPT-3.5, Claude, Gemini, and Meta AI, can contribute to the teaching and learning of general CSE courses rather than specifically coding-based courses. The method involved simulating a student query on the popular debate between CISC and RISC regarding computer architecture and analyzing the chat bot responses. This initial data collection served as the basis for ongoing comparative analysis aimed at determining the inherent teaching value of each LLM and its validity and reliability [8].

The emergence of large language models (LLMs) has revolutionized many fields, especially education, by offering powerful tools for personalized learning and automated assistance. These models have the potential to significantly improve the educational experience, especially in the field of computer science (CS), where the complexity and rapidly evolving nature of the topics present unique challenges and opportunities. This study presents a comparative evaluation of the transformative potential of LLMs in computer science education, with a particular focus on cyber security. Our study focuses on two leading LLMs: Open-nAI's Chat GPT and Google's Gemini Pro, using a three-pronged evaluation methodology. First, we analyze the subject matter within cyber security education to identify key topics and challenges for examination. Second, we carefully evaluate and compare the effectiveness of Chat GPT and Gemini across various factors in generating satisfactory answers. Finally, we explore the impact of using rapid engineering to improve the quality of responses generated by these AI tools. Through this holistic approach, our research aims to provide insight into the strengths, limitations, and potential avenues for improvement of these models, thereby enriching the ongoing discourse on the integration of LLMs into higher education [9].

The study assesses social and gender bias in Chat GPT, Gemini, and Claude AI. Unlike previous studies that used existing datasets, we used hand-crafted questions to more effectively detect biases. Basic simple questions provided unbiased responses, however, complex biased questions highlighted several concerns. Chat GPT had bias all the time, while Gemini had bias sometimes and the rest of the time it was not, or if it was, the bias was different, while Claude AI was mostly unbiased. Thus, this study shows that there is variation in the levels of bias across different AI models and therefore argues for improved bias strategies in AI to address the issue of fairness in the use of AI [10].

With the advent of large language models (LLMs) such as Chat GPT, Gemini, and LLaMA, there is no doubt that artificial intelligence will forever change the way education works. However, there is a gap between students from pre-K to 12th grade and LLMs. The instructions given to LLMs must be well-designed to be used effectively for education from pre-K to 12th grade. To make LLMs more appropriate for STEM educational purposes from pre-K to 12th grade, the author

developed a prototype of a rapid-engineered tool to fully utilize the educational potential of LLMs and reduce their use for academic dishonesty. The tool would allow a student to register by specifying the class they are taking, and then set a topic that the student would like to learn more about. Using rapid engineering techniques, the tool can prompt LLMs to produce educational content such as descriptions, questions and answers, AI-generated quizzes, and reviews, as well as ask LLMs to further simplify complex topics to aid understanding. An AI-enabled tool, which is essentially a virtual and personal mentor, could help further improve STEM education and make STEM more engaging for students, as it could explain complex topics in a way that students can easily understand. The tool and AI can help students understand the topic through interactive practice, rather than just memorizing facts and writing them down on paper. The tool presented in this paper will enhance STEP education with AI [11].

Since the release of various generative artificial intelligence (Gen AI) tools such as Chat GPT, Google Gemini, DALL□E, and Git Hub Copilot, there has been a great deal of debate about the impacts and implications of these tools for education. Currently, the existing literature discusses the opportunities, challenges, and possibilities of Gen AI, but few studies report and analyze empirical studies and educational practices that emerge from the use of Gen AI in educational settings. Next, in this scoping review (ScR), based on 146 studies retrieved from the SCOPUS, Web of Science (WoS), and ERIC databases, we analyzed the implications of integrating Gen AI into engineering and computer science education from pre-school to high school levels. We adopted an approach starting from bibliometric characteristics of studies in terms of authors, citations, years or topic clusters, and moving towards the identification of methodologies, strategies, tools and guidelines for AI literacy, learning outcomes and student and teacher perceptions, among others [12].

Design Thinking (DT), widely recognized as a structured method for fostering creativity and innovation, has received significant attention in research and practice across disciplines. However, with the rise of disruptive technologies such as artificial intelligence (AI), DT practices are gradually evolving, changing the innovation process. The study investigates the effectiveness of integrating generative AI into a product design thinking activity, using a single-group pretest and posttest design (i.e., without a control group). The time interval between the pretest and posttest measurements was four hours, which coincides with the duration of the DT activity. Conducted in a chemical engineering course at a private university in central Mexico, the study tasked nine students of average academic achievement with designing a new beverage. During the four-hour session, students used AI tools – Chat GPT, Perplexity and Gemini – at different stages of the design process, including empathy mapping, needs statements, idea classification, hill-writing and storyboarding [13].

The development of artificial intelligence (AI) has been widely applied in various sectors, one of which is education where it is used as a source of information to determine the effect of Chat GPT on the development and understanding of students in case-based learning. Case-based learning is a learning sector that requires critical thinking, cognitive skills and the ability to represent processed information, and with AI, students were expected to have more observations related to the topic of the case. The research was conducted to test the capabilities of Chat GPT compared to other AIs differentiated based on NLP groupings in the context of moderation. Gemini and Copilot became the other AIs that we chose to be additional variables in the research process. The analysis method used in the research was done by distributing questionnaires to a purposively selected 100 samples. The tool for the data analysis process was the use of SmartPLS 4.0 using the moderation model. From the data processing conducted, it was determined that, based on the aforementioned research model, Chat GPT influences the development of student knowledge by 65.4%, while in practice other AI variables can negatively interfere with Chat GPT output by 6%. As a result of this observation, it is shown that the Chat GPT comprehension index, which helps in assessing the level of student learning and knowledge, was dominant and consistent, based on the collected data on the significant level and comparison between Chat GPT and other artificial intelligences [14].

The study investigates students' knowledge, usage patterns, and perceptions of Generative Artificial Intelligence (Gen AI) tools, focusing on their potential applications in education. Using a structured questionnaire, data were collected from 167 respondents to assess familiarity with AI, Gen AI, and specific interfaces such as Chat GPT, Dall-E, and Google Gemini. The results show that while most respondents are somewhat familiar with AI and Gen AI, knowledge of specific tools varies significantly, with Chat GPT being the most recognized and used. Text-based tools dominate usage, primarily for tasks such as explaining concepts, summarizing content, and translating. Challenges that arise include issues with accuracy, ease of use, and specificity of instructions. Despite these challenges, respondents identify personalized learning resources, automated grading systems, and virtual tutors as the most valuable educational applications. The study highlights the transformative potential of Gen AI in education, while also emphasizing the need for improved tool design and expanded training to optimize its adoption [15].

Generative artificial intelligence (GenAI) has emerged as a valuable tool in educational technology, offering the potential to improve learning and teaching processes. While concerns such as fraudulent practices, algorithmic bias, privacy issues, and overreliance on technology persist, the benefits of GenAI are significant when used strategically. However, it is essential to view GenAI as an additional aid for students and educators, not a replacement for human-led instruction. Effective use of GenAI requires thoughtful implementation, including techniques

such as prompting and search-augmented generation (RAG). Prompting involves formulating questions or tasks for the AI, while RAG enhances the AI's ability to search for relevant information based on its training. The study focuses on the relationship between GenAI and students, excluding the roles of educators [16].

3. The basics of AI-based education

3.1. Basic characteristics of the application of AI in education

Education based on artificial intelligence (AI) is the application of computing devices and artificial intelligence technologies to improve learning, teaching and educational management processes. This type of education uses algorithms to adapt content to students, automate administrative tasks, personalize learning and develop intelligent tutoring systems.

Key features of AI education:

Personalized learning

– Systems monitor student progress and adapt the material to their abilities and pace.

– Example: AI platforms that suggest next lessons based on student results (eg Khan Academy, Squirrel AI).

Intelligent tutors and assistants

– Chat bots and virtual assistants help solve tasks, explain material and answer questions 24/7.

– They are used in e-learning and hybrid education models.

Automatic assessment and evaluation

– AI tools can grade multiple-choice tests, essay responses, and even analyze speech and presentations.

Learning analytics

– AI uses "learning analytics" to monitor engagement, identify at-risk students and optimize teaching methods.

Content creation with the help of AI

– Generation of teaching materials, quizzes and simulations in accordance with the curriculum.

Adaptive platforms

– Platforms that "learn from students" and optimize access to each individual.

Below are presented the advantages of applying AI in education as well as challenges and limitations (table 1).

Table 1. Advantages and challenges of applying AI in education

Benefits of AI in education		Challenges and limitations	
Accessibility	Learning anytime, anywhere.	**High-quality data**	Need with verified data
Individualization	Learning according to the style, abilities and needs of the individual	**Ethics and privacy**	Protection of researchers and students
Efficiency	Automation of tasks frees up time for teachers	**Technology addiction**	The need for technologies and digital inequality
Support for inclusion	AI tools can help students with special needs (eg speech to text)	**Dehumanization of education**	Loss of direct interaction with teachers

3.2. Model of application of Chat GPT and Gemini in education

The model of application of Chat GPT and Gemini (Google AI) in education can be presented through multiple dimensions that include teaching, learning, evaluation and development of digital skills. Below is a rough model of their application (figure 1):

Personalized learning:

– Description: Chat GPT and Gemini allow students to receive explanations adapted to their knowledge and pace.

– Application: Questions and answers in real time. Customized lessons and quizzes. Suggestions for additional learning based on interests.

Assistance to teachers

– Description: Tools can automate and facilitate lesson preparation.

– Application: Generation of teaching materials (lesson plans, worksheets, tests). Suggested activities for different learning styles. Analysis of student responses and creation of reports.

Writing and research support

– Description: Help students better structure essays and develop research skills.

– Application: Suggestions for writing and editing text. Help in formulating the research question. Explanation of methodology and academic writing style.

Development of digital and language skills

– Description: Digital literacy and communication skills are developed through interaction with models.

– Application: Language learning (grammar, vocabulary, conversation). Logical and critical thinking exercises. Programming and solving tasks in STEM fields.

Evaluation and formative assessment

– Description: AI tools can provide feedback on student progress.

– Application: Automatic checking of the correctness of answers. Formative

feedback and recommendations. Diagnostic testing and progress monitoring.

Ethics and responsible use

– Description: The educational system must ensure the proper use of tools.

– Recommendations: Learning about plagiarism and academic integrity. Developing a critical attitude towards AI responses. Discussions on the role and limits of artificial intelligence.

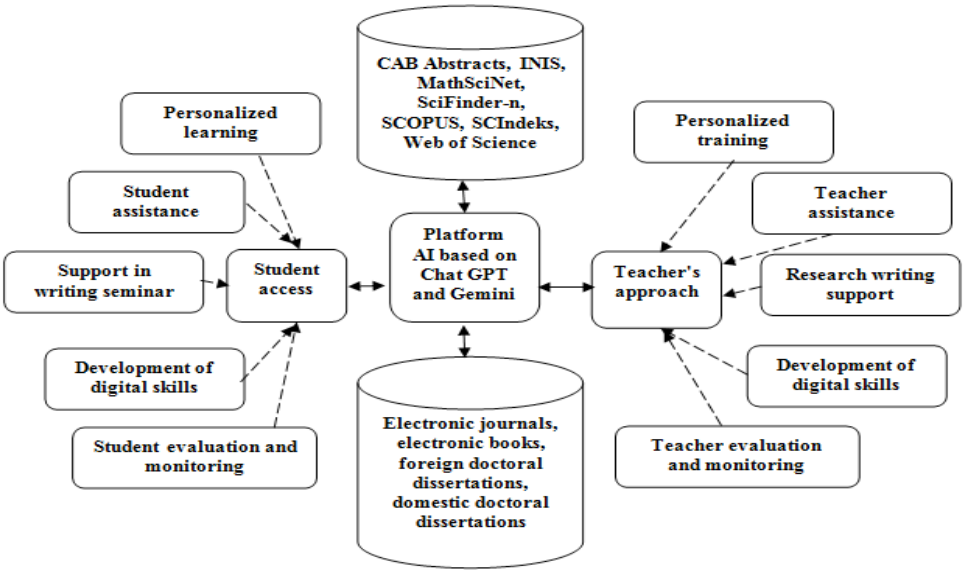

Figure 1. Innovative model of application of AI in education

Conclusion

Application of Chat GPT and Gemini model can improve the quality of education in higher education institutions when it comes to students and teachers and in scientific institutes when it comes to researchers, through personalization, efficiency and innovation. However, it is important that the use of AI in education takes place with pedagogical supervision, clearly defined rules and training of both teachers and students. Clearly defined rules, in addition to ethical norms that must be followed by everyone in the academic community, must also include legal norms with clear limitations so that abuses do not occur. Copyright must be defined separately for all sources in electronic (digital) form.

In particular, it should be noted that the application of AI technology such as the Chat GPT and Gemini platform in the academic community must be used as an auxiliary tool for developing creativity in innovative business models. Only an expert in his scientific field can compare the information presented by the Chat GPT

and Gemini platform, see the correctness of the results, the applied methodology, relevance, objectivity, errors and, based on them, form a critical opinion.

In accordance with the above, this paper presents an innovative model of the application of AI technology with the Chat GPT and Gemini platforms that are most widely used, where the basic guidelines for the development of other models in other economic sectors are highlighted. The basic "principles" that should be adhered to in order to avoid accidental or intentional abuses by individuals or due to the ignorance of the wider human population are shown.

REFERENCES

[1] GOERTZEL, B., PENNACHIN, C. (Eds.), Artificial general intelligence. Springer, 2007.

[2] LECUN, Y., BENGIO, Y., HINTON, G., Deep learning. Nature, 521(7553), pp. 436 – 444, 2015, https://doi.org/10.1038/nature14539.

[3] NIKOLIĆ, D., RADIČEVIĆ, V., PAVLOVIĆ, Z. G., Modeliranje arhitekture i infrastrukture inovativnog modela e-poslovanja. FBIM Transactions, 9(2), pp. 55 – 62. doi:10.12709/fbim.09.09.02.06.

[4] RALEV, V., ATMADZHOVA, D., Failure analysis in Passenger Bogies from the Railway System of the Republic of Bulgaria, IMK-14 – Research&Developement 27 (2021) 3, EN89-98, UDC 621, 2021, ISSN 0354-6829, doi: 10.5937/IMK2103089R.

[5] ATMADZHOVA, D., RALEV, V., Strength Analysis of Passenger Bogie Elements Operated in Bulgarian State Railways, I International Symposium Rail Transport in The Modern World, Higher Education Railway School of Professional Studies Belgrade, Serbia, 12 – 13.12.2019, pp. 1 – 6, 2019, ISBN 978-86-81101-32-2.

[6] STOYANOVA, P., Improvement of Spare Parts Stock Management System for Locomotive Depot, International Xxi Scientific - Expert Conference on Railways Railcon '24, October 10 – 11, Niš, Serbia, pp. 125 – 129, 2024, doi: 10.5937/Railcon24127S.

[7] BEROV, T., BORISOV, A., STOYANOVA, P., Analysis of the environmental impact caused by urban freight transport and logistics" Sofia VTU, 6 – 7.07.22, Scientific Journal Mechanics Transport Communications, vol.20, issue 3, 2022, ISSN 2367-6620 (online). https://mtc-aj.com/library/2295.pdf.

[8] NATH, S., YOON, S. Y., WIP: Beyond Code: Evaluating Chat GPT, Gemini, Claude, and Meta AI as AI Tutors in Computer Science and Engineering Education, 2024 IEEE Frontiers in Education Conference (FIE), Washington, DC, USA, pp. 1 – 5, 2024, doi: 10.1109/FIE61694.2024.10893528.

[9] NGUYEN, T., SAYADI, H., ChatGPT vs. Gemini: Comparative Evaluation in Cybersecurity Education with Prompt Engineering Impact,2024 IEEE Frontiers in Education Conference (FIE), Washington, DC, USA, pp. 1 – 9, 2024, doi: 10.1109/FIE61694.2024.10893499.

[10] SHETTY, P., SHRISHMA RAO, V. S., MURALIKRISHNA, S. N., Assessing Bias in Large Language Models: A Comparative Study of ChatGPT, Gemini, and Claude, 2024 (MoSICom), Dubai, United Arab Emirates, pp. 133 – 137, 2024, doi: 10.1109/MoSICom63082.2024.10881888.
[11] LI, M. Z., Using Prompt Engineering to Enhance STEM Education, 2024 IEEE Integrated STEM Education Conference (ISEC), Princeton, NJ, USA, pp. 1 – 2, 2024, doi: 10.1109/ISEC61299.2024.10664775.
[12] ÁLVAREZ ARIZA, J., BENITEZ RESTREPO, M., HERNÁNDEZ HERNÁNDEZ, C., Generative AI in Engineering and Computing Education: A Scoping Review of Empirical Studies and Educational Practices, in IEEE Access, vol. 13, pp. 30789 – 30810, 2025, doi: 10.1109/ACCESS.2025.3541424.
[13] CHANS, G. M., MERINO-SOTO, C., CHÁVEZ, S. S., GARCÍA CASTRO, J. A., ZAVALA, G., RODRIGUEZ, E. S., Integrating Generative AI Into Design Thinking: Assessing Impact on Creativity and Innovation in STEM Education, 2025 (EDUCON), London, United Kingdom, pp. 1 – 7, 2025, doi: 10.1109/EDUCON62633.2025.11016312.
[14] TANUWIJAYA, S., AGUSTINUS, J., HERIPRACOYO, S., Analysis the Benefits of ChatGPT Implementation on Student Knowledge Development in Case-Based Learning (CBL), 2024 (ICORIS), Surakarta, Indonesia, pp. 1 – 6, 2024, doi: 10.1109/ICORIS63540.2024.10903835.
[15] EPAMINONDA, E., KTORIFOU, D., MICHAILIDIS, M., EFTHYMIOU, L., Exploring Students' Familiarity, Usage Patterns, and Perceptions of Generative AI Tools in Education, 2025 (EDUCON), London, United Kingdom, pp. 1 – 7, 2025, doi: 10.1109/EDUCON62633.2025.11016320.
[16] RANA, S. P., DEY, M., PATEL, P., REQUENA, J., FU, C., Prompting and Rag Vs. Student Engagement and Comprehension in Educational Technology, 2025 (EDUCON), London, United Kingdom, pp. 1 – 7, 2025, doi: 10.1109/EDUCON62633.2025.11016579.

✉ **Dr. Zoran G. Pavlović**
ORCID iD: 0000-0001-6076-1811
Departments School of Railroad Transport Academy
of Technical and Art Applied Studies
24, Starine Novaka, Belgrade, Republic of Serbia
E-mail: zoran.pavlovic@vzs.edu.rs

✉ **Dr. Ana Savic**
ORCID iD: 0000-0002-8099-1136
Department of Electrical Engineering and Computer Science Academy
of Technical and Art Applied Studies
24, Starine Novaka, Belgrade, Republic of Serbia
E-mail: ana.savic@atuss.edu.rs