



PREPAREDNESS FOR ARTIFICIAL INTELLIGENCE IN EDUCATION

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Abstract: The continuous development of artificial intelligence-based tools makes their emergence inevitable in education as well as other fields of life. This article presents findings of a mixed method study aimed at investigating the current perceptions and potential applications of AI in Hungarian educational settings. Through interviews with high school teachers, university lecturers and questionnaire with students, four key research questions were explored: the existing knowledge base regarding AI applications, the perceived integratability of AI into educational practices, comprehensive opinions on AI's role in education, and exploring the potential of artificial intelligence-based applications to enhance the learning process of programming education. The findings contribute to the ongoing discourse surrounding AI's role in education, offering insights into the challenges and opportunities present in the Hungarian educational context.

Key words: education, artificial intelligence, programming education

1. Introduction

Artificial intelligence is continuously evolving and is increasingly present in various aspects of life. It is no longer limited to solving specific, predefined tasks; it can now answer questions in different fields, assist in problem-solving through the use of chatbots (such as ChatGPT, Gemini), translate texts (e.g., DeepL), generate image and video content (e.g., Microsoft Copilot), give support for websites' accessibility (Abonyi-Tóth, 2023) and even create and debug code (e.g., GitHub Copilot (Zhang et al., 2023)).

Due to the vast array of infinite possibilities, it is inevitable that artificial intelligence will become increasingly prevalent in education in the future (Holmes & Tuomi, 2022; Sperling et al., 2024). This trend is already partly underway, as students regularly use these tools for solving homework, assignments, and during study sessions. However, it is important to consider that critical thinking and creativity plays a crucial role in interpreting and using the responses (Xiaoming, 2023), as current tools often come with significant limitations (Memarian & Doleck, 2023) and may occasionally provide incorrect answers. Nevertheless, the accuracy of these tools is continuously improving. ChatGPT, for instance, can solve simpler programming tasks with success rates ranging from 50% to 90%, which can be further enhanced through deliberate review (Barilla, 2023; Bende, 2023; Destefanis et al., 2024; Hochmair et al., 2024; Kabir et al., 2023).

Artificial intelligence can not only play a role in learning but also assist teachers in their work, for example, by generating and grading assignments, allowing teachers to focus more time on individual student needs and AI can answer the students' questions immediately (Holmes & Tuomi, 2022; Alexandara, 2023; Vukoječić & Krstić, 2023). Several studies have shown improvement in teaching efficiency and teacher competencies through the use of AI (Chiu et al., 2023). Nevertheless, AI readiness remains low across all aspects of education, necessitating improvement through self-directed or organized training (Luckin et al., 2022).

AI not only can help in specific problems, but it can also help providing equal opportunities and possibilities: AI "may bridge the gap between individuals from distinct demographic backgrounds" (Wang et al., 2023).

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While on the other hand usage of AI could have negative impacts as well: loss of human connection, reduced critical thinking, and creativity, unequal access and technological divide (Al-Zahrani, 2024).

In Hungarian education, artificial intelligence is currently used less frequently to support teaching; currently, there is more of an emphasis on exploring and testing possibilities. Thus, through interviews, I examined and analyzed the following research questions:

1. What prior knowledge do participants in Hungarian education have regarding current applications of artificial intelligence? (Q1)
2. To what extent and by what methods do they consider artificial intelligence integratable into education? (Q2)
3. What is their comprehensive opinion on artificial intelligence as a participant in education? (Q3)
4. Can artificial intelligence-based applications assist in the learning process of programming education? (Q4)

In recent times, there have been increasing efforts to familiarize education participants with the characteristics, possibilities, shortcomings, and limitations of artificial intelligence. Currently, teachers in public education and university instructors can acquaint themselves with various tools and methods within the framework of in-service training. More and more experiments are being conducted to examine the effectiveness of AI in education. At the same time, approaches from the other side are also playing a role: establishing a regulatory framework for possible applications in assignments, publications, and theses or how to cite AI generated contents (ELTE PPK, 2023).

2. Research on teachers' and students' knowledge and attitude regarding the use of AI in education

This research tried to find answers to research questions Q1, Q2, and Q3.

2. 1. Research instruments

Interview guide. During the interview, following the introduction and experience overview for the participants, the following topics were discussed:

1. What artificial intelligence-based tools are you familiar with?
2. Are you currently using artificial intelligence-based tools in education, and if so, which ones and how?
3. What artificial intelligence-based tools do you plan to use in education/learning?
4. To what extent are the currently known tools capable of supporting education?
5. What advantages might arise from integrating artificial intelligence into education?
6. Do you see any problems or risks associated with integrating artificial intelligence into education?
7. Overall, how would you describe your attitude towards artificial intelligence and its integration into education?

Questionnaire. The questionnaire contained the same questions, which the subjects could be answered freely.

2. 2. Participants

The subjects of the interviews were high school teachers, university lecturers (N=14), while the questionnaire was filled by university students (N=53).

2. 3. Results

In the first question, the goal was to survey well-known artificial intelligence-based applications. The responses included the following groups and tools within them:

- Chatbots: ChatGPT (every subject listed it as a known application, which indicates its current superiority in the market), Microsoft Copilot, Bard/Gemini, Mistral, Perplexity, Emerson, Claude, Elicit. (Elements of this group appeared in the most responses.)
- Image generator: DALL-E, Midjourney, Adobe Firefly
- Music generator: Suno
- Speech recognition: Whisper
- Video generator: Sora, Vidio
- Mathematical: Symbolab
- Software development: GitHub Copilot
- Complex application: Galaxy AI
- Gaming: Stockfish (Chess), AlphaGo (Go)

Mostly five applications were mentioned: ChatGPT, Copilot, Dall-E, Midjourney, Bard/Gemini (Figure 1), for programming tasks the subjects mentioned two applications only: ChatGPT, GitHub Copilot.

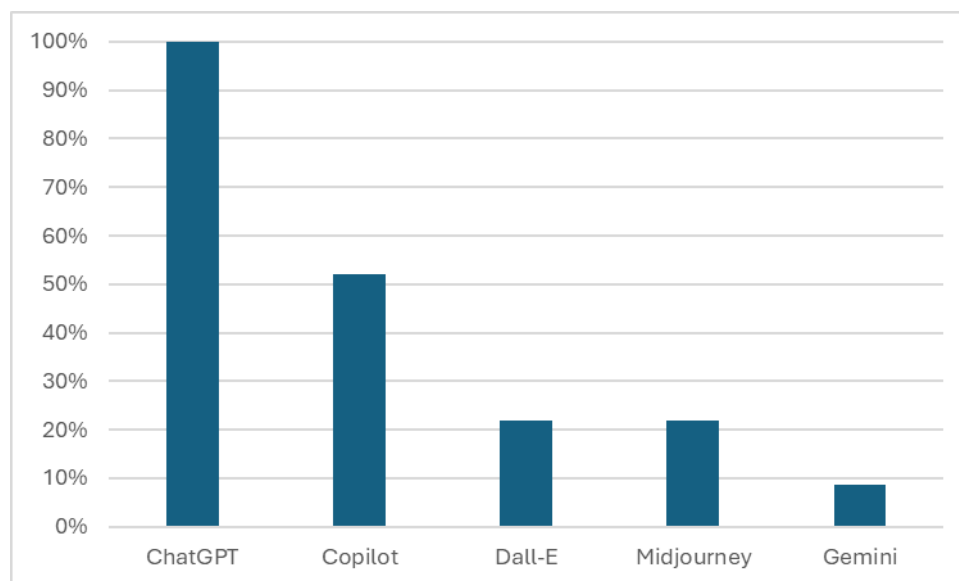


Figure 1. Mostly mentioned AI applications

The subjects use AI-base application for the following tasks, goals:

- debugging during development,
- explaining steps,
- searching for information,
- accelerating development,
- generating code,
- generating practice tasks,
- summarizing material.

Responses to the question of how capable current AI tools are in supporting education were mixed. Some believe they are capable, while others think less so. Among the latter, it is noted that they can respond well to smaller questions, but may not necessarily solve larger tasks correctly. Additionally, a foundational knowledge is required for users to determine whether the answers provided are indeed correct. Without this, the learner could be easily misled.

The subjects listed the following main advantages for using AI tools in education: sparing time (in preparation time for teachers, solving homework), faster debugging, more time for creative tasks, easier, more approachable self-learning process (generating tasks), immediate answer. They list the followings for disadvantages: easier to cheat in exams, excessive reliance, impairs the effectiveness of learning, may undermine critical thinking, legal issues in data usage.

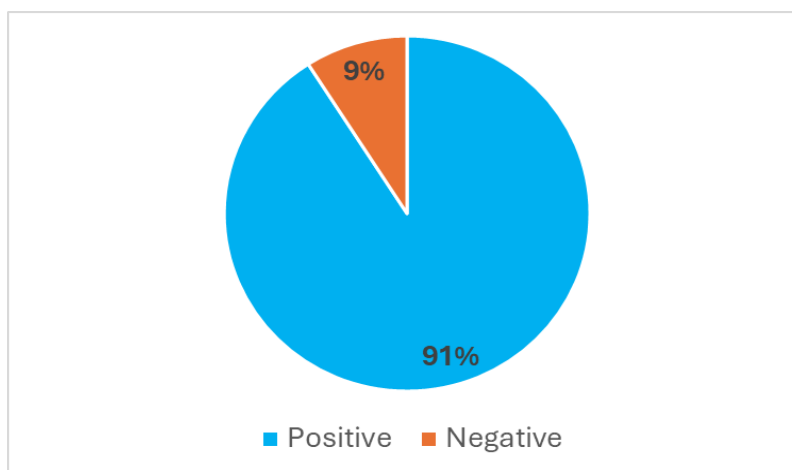


Figure 2. *Subjects' attitude towards AI in programming education*

During the final question, I inquired about their general attitudes regarding the integration of AI into education. Predominantly (91%), they hold a positive view on this matter (Figure 2), which was already hinted at by their responses to the other questions, as they mostly already utilize AI in their learning processes.

2. 4. Summary and discussion

Based on the previously presented results, it can be said that the respondents are familiar with artificial intelligence-based tools, listing a relatively wide range of different types of applications. Their attitude towards this technological innovation and its adaptability to education is significantly positive. However, its effectiveness and usability in its current state are questionable, as there are many incorrect, hallucinated responses. Therefore, those who lack sufficient knowledge in the queried subject area can be easily misled.

3. Research on efficiency of AI in programming tasks

Based on interviews and questionnaires, I aimed to investigate the efficacy of popular artificial intelligence-based tools in providing accurate responses, trying to find the answer to research question Q4. Chatbots are primarily capable of supporting learning in programming-related topics; hence, applications falling into this subclass were included in the experiment. Specifically, those that are free to use (thus not impeding educational use) and usable in multiple languages (not just English) were selected.

3. 1. Examining tasks for beginners

Initially, the ability to provide correct responses in tasks requiring programming theorems was assessed. The examined categories included the following: whether a task can determine, based on its text, which programming theorem is required for its solution; whether it can discern correct/incorrect solutions based on the task's text and an implementation; whether it can solve a task based on its text; and whether it can provide individual practice tasks based on a given topic and programming theorem.

Each question was examined using the following programming theorems: summation, counting, maximum selection, decision-making, selection, linear search, copying, filtering, and partitioning. While in (Bende, 2023) I previously examined correctness using Bard/Gemini and ChatGPT, the present study expands upon this by incorporating responses from interviews and questionnaires, further augmented by Microsoft Copilot.

Table 1. Summary of AI-based applications' effectiveness

	Bard/Gemini	ChatGPT	MS Copilot
Recognition of programming theorems	5/8	8/8	3/8
Checking correct solutions	8/8	8/8	7/8
Checking incorrect solutions	4/7	7/7	3/7
Solving tasks (short, detailed)	7/8, 1/7	7/8, 5/7	8/8, 7/7
Creating personalized tasks	4/8	7/8	6/8
Complex tasks	3/4	4/4	3/4
SUM	32/50 (64%)	46/50 (92%)	37/50 (74%)

As we see on Table 1 none of the listed applications could get 100% accuracy, while ChatGPT had the most correct answers.

3. 2. Examining more complex tasks

Following the examination of tasks requiring programming theorems, I proceeded to investigate programming topics and tasks that require various technologies for their solutions. Similar to the previous section, I utilized Gemini, ChatGPT, and MS Copilot as the targets of the examination.

In the first task the objective was to create a simple website featuring various predetermined tags and content (T1). All three platforms completed this task correctly, although Gemini initially refrained from responding, citing security reasons, but eventually provided a correct response upon a second request.

In the second task (T2), applications were required to develop a small JavaScript game to be displayed on a canvas (Figure 3). The implementation included object movement and user input handling. ChatGPT successfully provided a correct implementation on the initial attempt. However, minor deficiencies were observed with Copilot and Gemini, such as failing to consider the size of objects when displaying them and one object remaining stationary. These issues were promptly addressed after receiving feedback, resulting in a correct implementation by the end of the process.



Figure 3. Solution of the second task in the complex category

Following this, within a more complex web application context, the objective was to display a paginated table. Data stored in a CSV file on the PHP server-side was requested by the client via AJAX, with JavaScript aiding in its presentation (T3). Initially, ChatGPT stored the data within the source code instead of a separate file, which it corrected upon additional request. However, subsequently, the table header appeared twice (once in the file and again in the HTML source). Despite multiple prompts, it couldn't rectify this, but with some assistance, it managed to provide a correct implementation. For Gemini, there was an error: it referenced a variable that didn't exist in the given context. Similarly to ChatGPT, with a few targeted questions, it succeeded in providing the correct solution. Microsoft Copilot initially didn't include pagination buttons, but after two inquiries, they were eventually added (initially, only in the JavaScript file, with a separate request including them in the HTML file as well).

During the subsequent task, the goal was to write a longer C program capable of performing basic file operations through a menu (such as listing, adding, modifying, and deleting rows), and it also included an additional process where fork, pipe, and message queue had to be used (T4). In the case of ChatGPT, a few includes were missing, and there was a syntax error which was corrected after an additional prompt message, and I provided further clarification on which tools to use for the additional process, thus making the code functional. However, there was a small step missing from the extra process, which was rectified after another prompt, resulting in a complete solution. The other two applications did not provide a complete solution despite repeated requests. There were instances where it interrupted the code and only provided its further parts upon separate requests. They indicated omitted code snippets with comments or described them in text, thus they were unable to provide a correct implementation under these circumstances.

Table 2. *Effectiveness of AI-based applications in complex programming tasks*

	Bard/Gemini	ChatGPT	MS Copilot
T1 (HTML)	✓	✓	✓
T2 (JS)	✓	✓	✓
T3 (JS, PHP)	✓	✓	✓
T4 (C)	X	✓	X

While ChatGPT solved all of the tasks after a few extra questions, the others couldn't give a fully correct solution (Table 2), but it doesn't mean that they couldn't help in them. Both gave important advice on the solution and a partially correct answer.

4. Conclusion

Based on the interviews and questionnaires, it is evident that participants in education not only are familiar with artificial intelligence-based tools but also actively use them across various aspects of life, including the educational process itself. The mentioned tools by the subjects indicate that not only chatbots but also other tools integrated into previously used programs have emerged and are actively utilized (Q1). Concerning programming, participants primarily use these tools for understanding topics, debugging, and expediting the development process, but there's also an emergence of task generation for practice, which can aid individual progress in the learning process (Q2). As observed from the final question of the questionnaire and summarized in Figure 2, the majority of participants hold a positive stance towards this technological advancement and find its integration into various aspects of education beneficial (Q3).

The effectiveness of the tools in providing correct responses was examined through various approaches. Primarily, I evaluated different aspects through programming tasks that require knowledge of programming theorems, then I assessed their various programming abilities through more complex tasks. In terms of efficiency, among the three examined tools (Gemini, ChatGPT, Microsoft Copilot), ChatGPT consistently provided the highest number of correct responses (Table 1).

However, in several instances, additional requests or questions were necessary following the receipt of incorrect or incomplete responses. Therefore, it can be concluded that for those who do not possess sufficient prior knowledge in the given subject area, these tools are unable to provide fully satisfactory responses, thus not effectively assisting in the learning process. However, if the user possesses critical thinking skills and minimal prior knowledge, they can recognize these errors, making the application a useful tool in education, both from the instructor's perspective (task generation, lesson preparation) and from the learner's perspective (practice, assessment) (Q4).

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