DEVELOPING CRITICAL THINKING IN THE AGE OF ARTIFICIAL INTELLIGENCE

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ABSTRACT: Developing Critical Thinking in the Age of Artificial Intelligence.
This paper examines the impact of artificial intelligence (AI) on students' cognitive abilities, particularly on critical thinking, and strategies for developing students' critical thinking skills in an AI-driven environment. We believe that critical thinking is essential in preserving freedom of conscience and in developing effective problem-solving skills in current circumstances. AI has become widely used in daily life as well as in academic activities, with implications that are not yet fully understood and managed. The use of artificial intelligence in education offers the benefit of personalized education in terms of content, feedback, and evaluation, the possibility of simulated learning through virtual reality, augmented reality, and mixed reality technologies, and other advantages. However, these advantages are accompanied by potential drawbacks, including overreliance on AI, diminished motivation, reduced memory retention, and a decline in students' analytical and problem-solving skills. Concerns are also raised regarding mental health, social isolation, and the effects of attentional overload caused by digital technologies. Critical thinking, which involves analysis, evaluation, reasoning, and informed decision-making, is especially at risk. The article emphasizes that these skills are cultivated rather than innate, and should therefore be intentionally developed through educational practices. Yet, traditional teaching methods—focused heavily on memorization—often fail to promote such competencies. The widespread availability of AI tools further complicates this issue by offering ready-made solutions that may replace independent reasoning. Educators should not ban AI, but guide students in using it responsibly. This involves training students to question AI-generated content, verify information across sources, and use AI as a tool for deeper understanding rather than as a substitute for thinking. Practical strategies include designing assessments that foster analysis and creativity, encouraging open-ended problem-solving, and integrating philosophy or log-

ic-based courses to strengthen reasoning. Teachers themselves must also be equipped to foster critical thinking, though systemic issues such as large class sizes, rigid curricula, and limited instructional time hinder these efforts.

Keywords: *critical thinking, artificial intelligence, educational strategies*

Introduction

One of the most notable developments in recent years has been the impressive growth of artificial intelligence (AI), which has become an integral part of our daily lives. Besides being used as virtual assistants or for personalized commercial recommendations, AI has become widely used in academic activities, with implications that are not yet fully understood and managed. The extensive use of social media and the internet among teens has already raised concerns about their ability to focus attention for longer periods. The surge of AI and its use for fulfilling academic tasks is an additional challenge for developing critical thinking in students (and not only).

Excessive use of digital tools leads to attentional overload, when the demands of the environment exceed an individual's capacity to process them[1]. The mind becomes overstimulated with notifications, updates, alerts, and so on, and attention is constantly divided among several tasks. We live in the age of information, but ironically, our ability to process this information has decreased. The strong need to constantly update generates fears, such as FOMO – fear of missing out.

This paper examines the impact of artificial intelligence on students' cognitive abilities, particularly on critical thinking, and presents several strategies for developing students' critical thinking skills in an AI-driven environment. We believe that critical thinking is essential in preserving freedom of conscience and in developing effective problem-solving skills under current circumstances.

The use of artificial intelligence in education

The use of artificial intelligence in education offers the benefit of personalized education in terms of content, feedback, and evaluation, the possibility

1 Mathura Shanmugasundaram, Arunkumar Tamilarasu, "The impact of digital technology, social media, and artificial intelligence on cognitive functions: a review", in *Front. Cognit.* 2/2023. doi: 10.3389/fcogn.2023.1203077 (accessed at 11.08.2025).

of simulated learning through virtual reality, augmented reality, and mixed reality technologies, and other advantages[2]. Being used in so many fields, artificial intelligence may no longer be excluded from the educational field, especially considering the high level of familiarity students have with these technologies. Personalized education and AI-supported one-to-one tutoring may encourage students' engagement and performance[3].

Bai et al. list the positive effects of using chatbots like ChatGPT by students: personalized and interactive learning, 24/7 support, spaced learning, and reduced pressure for those who prefer to avoid human interaction. However, some of these effects might have negative aspects[4]. For example, 24/7 support might encourage an unhealthy schedule for students, and the possibility of avoiding human interaction might lead to isolation and mental health issues. The same authors also identify the negative effects of using chatbots, such as overreliance on AI that affects motivation and memory abilities, as well as diminished critical thinking.

Other researchers also express their concerns regarding the negative effects of using artificial intelligence in the educational system from increasingly younger ages. An analysis by Shanmugasundaram and Tamilarasu published in 2023 presents several worrying effects of using digital technology, social media, and artificial intelligence on cognitive functions – attentional overload, reduced productivity, decreased memory retention, increased stress levels, digital dementia (memory loss, attention deficits, poor communication skills, poor decision-making abilities), internet addiction, reduced social skills, and empathy, among others[5].

One of the most concerning implications of using digital technology and AI is the negative impact on critical thinking. Critical thinking involves

2 Rebecca McNulty, Roxana Paraschiv, "Integrating artificial intelligence in teaching and learning" in Safary Wa-Mbaleka (Ed.), *The Sage handbook of higher education instructional design*, Sage, 2025, pp. 642–655.

3 Abatihun Sewagegn, Boitumelo Molebogeng Diale, "Empowering learners using active learning in higher education institutions", in *IntechOpen*, 2019 http://doi.org/10.5772/intechopen.80838 (accessed at 18.08.2025).

4 Long Bai, Xiangfei Liu, Jiacan Su, "ChatGPT: the cognitive effects on learning and memory", in *Brain-X*, 1(3)/2023, https://doi.org/10.1002/brx2.30 (accessed at 20.05.2025).

5 Mathura Shanmugasundaram, Arunkumar Tamilarasu, "The impact of digital technology, social media, and artificial intelligence on cognitive functions: a review", in *Front. Cognit.* 2/2023. doi: 10.3389/fcogn.2023.1203077 (accessed at 11.08.2025).

comparing and analyzing information, and also patience, time, concentration, deep thinking, and analytical abilities—all of which are affected by extensive use of technology. The rapid spread of fake news in recent years is linked to social media and internet access, as well as to the decline in the ability to accurately analyze the information received.

AI tools have eased many of our tasks, but when students use them to fulfill their academic requirements, their problem-solving abilities are impacted. For example, we all recognize the importance of solving math problems in developing cognition in students, but relying on AI instead of personal intelligence to solve these problems affects the ability to think independently. AI offers rapid solutions, which reduces students' capacity to search for solutions patiently.

Among the many uses of artificial intelligence by students, the one that raises the most concerns is its potential to replace personal thinking and effort in fulfilling academic tasks. AI tools, such as ChatGPT, are constantly improving and performing increasingly complex tasks, offering human-like solutions to students' assignments.

The impact of artificial intelligence on critical thinking

Critical thinking is not a new concept, but its importance in the education field is increasing in the context of the present challenges. Critical thinking has its roots in philosophy, which focuses on the qualities of an ideal critical thinker—such as being inquisitive, open-minded, objective, well-informed, and flexible. Since a perfect critical thinker does not exist, cognitive psychologists have aimed to identify the essential skills for critical thinking—such as analysis, interpretation, reasoning, seeking evidence, and deduction. These skills are developed rather than innate, making the educational system a key part of discussions on critical thinking. The well-known Bloom's taxonomy describes six levels of thinking and learning—knowledge, comprehension, application, analysis, synthesis, and evaluation[6]. The last three levels are considered to represent critical thinking. Emily Lai, reviewing the literature on critical thinking, summarizes the abilities of a critical thinker that researchers agree on: "analyzing arguments, claims or evidence, making inferences using inductive or deductive

6 Benjamin Bloom (Ed.), *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain*, New York, David McKay, 1956.

reasoning, judging or evaluating, making decisions or solving problems, asking and answering questions for clarification, defining terms, identifying assumptions, interpreting and explaining, reasoning verbally, predicting, and seeing both sides of an issue "[7].

There is not a unique definition as critical thinking is "a multi-dimensioned and multifaceted human capability"[8]. The Foundation for Critical Thinking defines this process as "the art of analyzing and evaluating things with a view to improving it"[9]. The Australian Council for Educational Research provides a comprehensive definition that helps us understand the main features of critical thinking:

"To think critically is to analyze and evaluate information, reasoning, and situations, according to appropriate standards, for the purpose of constructing sound and insightful new knowledge, understandings, hypotheses, and beliefs. Critical thinking encompasses the subject's ability to process and synthesize information in such a way that it enables them to apply it judiciously to tasks for informed decision-making and effective problem-solving"[10]. Critical thinking is an essential ability that enables students "to solve problems effectively"[11].

Duran names the use of artificial intelligence " a double-edged sword"[12], offering both the benefits of increased educational efficiency and

7 Lai, Emily R, Michael Bay-Borelli, Robert Kirkpatrick, Anli Lin and Changjiang Wang."Critical Thinking: A Literature Review Research Report." (2011).

8 Jonathan Michael Spector, Shanshan Ma, "Inquiry and critical thinking skills for the next generation: from artificial intelligence back to human intelligence", in *Smart Learn. Environ*, 6/2019, https://doi.org/10.1186/s40561-019-0088-z (accessed at 10.08.2025).

9 Richard Paul, Linda Elder, *The Miniature Guide to Critical Thinking Concepts and Tools*. Foundation for Critical Thinking, 2014, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.criticalthinking.org/files/Concepts_Tools.pdf (accessed at 25.07.2025).

10 Jonathan Heard, Claire Scoular, Daniel Duckworth, Dara Ramalingam, Ian Teo, "Critical Thinking: Definition and Structure". Australian Council for Educational Research, 2020, https://research.acer.edu.au/ar_misc/38 (accessed at 10.07.2025).

11 Lisa Snyder, Mark Snyder, "Teaching Critical Thinking and Problem Solving Skills" in *The Delta Pi Epsilon Journal*, 50(2)/2008, 90–99 https://eric.ed.gov/?id=EJ826495 (accessed a 9.07.2025).

12 Volkan Duran, "Analyzing teacher candidates' arguments on AI integration in education via different chatbots", in *Digital Education Review*, 45/2024, p. 68–83, https://doi.org/10.1344/der.2024.45.68-83 (accesed at 12.08.2025).

personalized learning as well as the concerns regarding reduced human interaction and diminished critical thinking abilities. A systematic literature review by Melissa et al. highlights the negative effects of AI on students' analytical thinking skills and cognitive abilities, along with ethical issues like plagiarism[13]. The study also identifies possible benefits of using AI on learning and thinking, suggesting that the subject has to be further investigated.

Developing students' critical thinking skills

In 1941, Edward Glaser analyzed the relation between critical thinking and education and identified three conditions for "the ability to think critically": 1) the disposition to approach problems and subjects in a thoughtful way; 2) knowledge of methods of logical inquiry and reasoning; 3) the ability to apply these methods effectively[14]. The curriculum ought to be adapted in order to enable students to fulfill these conditions. Students must not only possess information, but also be able to evaluate it, make use of it, and make sound decisions based on it.

In 1979, Clement stated that although we should teach students how to think, we often teach them what to think[15], highlighting the need to develop critical thinking skills. Unfortunately, as Snyder states, "traditional instructional methods use too many facts and not enough conceptualization; too much memorizing and not enough thinking"[16]. While memorization has its place, it is crucial to also teach and encourage students to analyze, evaluate, and especially apply their knowledge. Assessments should also be designed to promote critical thinking rather than just memorization, by using open-ended questions, real-world problems, or ill-structured

13 Rahyuni Melisa, Ashadu Ashadi, Anita Triastuti, Sari Hidayati, Achmad Salido,Priska Ero, Cut Marlini, Zefrin Zefrin. Zaki Al Fuad, "Critical Thinking in the Age of AI: A Systematic Review of AI's Effects on Higher Education", *Educational Process: International Journal*, 14/2025, https://doi.org/10.22521/edupij.2025.14.31 (accessed at 20.08.2025).

14 Edward Maynar Glaser, *An experiment in the development of critical thinking. New York, Teachers College of Columbia University, Bureau of Publications, 1941.*

15 John Clement, "Introduction to research in cognitive process instruction", in jack Lochhead and John Clement (Eds.), *Cognitive process instruction*, Hillsdale, Lawrence Erlbaum Associates, 1979.

16 Lisa Snyder, Mark Snyder, "Teaching Critical Thinking and Problem Solving Skills" in *The Delta Pi Epsilon Journal*, 50(2)/2008, 90–99 https://eric.ed.gov/?id=EJ826495 (accessed a 9.07.2025).

problems[17] that require students to present arguments and explain their reasoning. Instead of just reproducing theoretical knowledge, students can be asked to apply this knowledge to real-life practical situations.

Instead of using artificial intelligence just to fulfill academic requirements, students should be trained to utilize it for gaining different perspectives, accessing additional information, or considering counterarguments. It is also essential for students to question the answers provided by chatbots, verify them with other sources, and evaluate their accuracy. Rather than discouraging students from using AI for their assignments, professors should help students use these tools more effectively to develop a more nuanced understanding of a subject. Additionally, students must be trained to critically assess AI responses and verify their sources.

Professors can incorporate AI in classrooms in different ways, making teaching and learning more attractive in a world dominated by technology. But besides that, they must teach students to interact properly with AI and to be aware of its limits and dangers. The instructional content must adapt to the fast-changing world we live in. A good example in this area is teaching students about information and communication technology. Today, students no longer need to be taught how to operate computers and other devices. Instead, they need digital literacy, defined by UNESCO as "the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship"[18].

A recent study using records of more than 600,000 students from the USA showed that students who study philosophy have "better verbal reasoning abilities and more curiosity, intellectual rigor, and open-mindedness"[19]. This means that studying philosophy improves critical thinking

17 The ill-structured problems are not clearly defined, do not have a single correct solution or a unique path to resolution. Solving these problems requires critical reasoning, creativity, and the ability to make decisions under conditions of uncertainty, being specific to complex real-life situations.

18 UNESCO, *What you need to know about literacy*, https://www.unesco.org/en/literacy/need-know (accessed at 13.08.2025).

19 Michael Prinzing, Michael Vazquez, "Studying Philosophy Does Make People Better Thinkers", *Journal of the American Philosophical Association, 1/2025*, https://www.cambridge.org/core/journals/journal-of-the-american-philosophical-association/article/studying-philosophy-does-make-people-better-thinkers/45A7DE8F37BE4698265BD54490109D4A (accessed at 20.08.2025).

abilities and can be a valuable tool in developing these skills. Unfortunately, in Romania, interest in studying philosophy is declining in both high schools and universities.

Conclusions

Artificial intelligence has become integrated into many aspects of our lives and is no longer just an auxiliary element in education. Clear advantages include personalized learning, quick feedback, content tailored to individual needs, as well as easier management of certain administrative tasks. However, the excessive use of artificial intelligence by students raises concerns about its effect on cognitive skills and critical thinking.

In the Romanian educational system, the development of critical thinking has not been considered a priority. The rapid growth of AI technologies, with their significant implications, underscores the urgent need to develop this skill. While for a long time the emphasis was on memorization, the availability of information at the click of a button makes it increasingly important for students to analyze, evaluate, synthesize, question information, and find multiple solutions to problems. These skills are crucial for students to adapt to future professional challenges. As the world evolves quickly, such skills will be essential for successful adaptation. Therefore, introducing critical thinking courses at all educational levels is a necessary step that can no longer be overlooked.

To teach students how to think critically, educators need proper training themselves. However, teacher training has traditionally focused more on delivering content than on fostering critical thinking. Standardized curricula also do not promote individual reasoning, and developing these skills requires extra time—something teachers rarely have. Large class sizes and busy syllabi further impede the effective development of critical thinking skills among students. Given the rapid access to information provided by both the internet and artificial intelligence, school and university curricula need to be updated so they do not mainly focus on transmitting information but instead on its effective and accurate use. This involves dedicating time and instructional content to teach and develop students' critical thinking and problem-solving skills.

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Declaration regarding AI use

- AI-based tools (Grammarly and ChatGPT) were used to assist with translation and language editing of certain portions of this paper.
- The author reviewed, revised, and assumes full responsibility for the final content.