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The Crisis of Critical Thinking in AI-Assisted Education

Liliana Mata

Vasile Alecsandri University of Bacau, Roma Mohammadpourkachalami nia

Abstract: This editorial examines the emerging challenges of preserving critical thinking in AI-assisted education. While generative artificial intelligence can enhance learning efficiency and support complex intellectual tasks, it may also encourage cognitive substitution, where students rely on AI-generated solutions without developing independent reasoning skills. Drawing on recent empirical research, the editorial highlights the distinction between task performance and genuine understanding. It emphasizes the need to reconsider educational assessment by evaluating independent reasoning, critical engagement with AI-generated content, and the transfer of learning. The editorial argues that effective AI integration should strengthen rather than replace students' intellectual engagement, ensuring that technological advancement supports the development of critical thinking and intellectual independence.

Keywords: AI-assisted education; cognitive offloading; critical thinking; educational assessment; generative artificial intelligence.

Introduction

Generative artificial intelligence (AI) has fundamentally changed the relationship between knowledge, learning, and intellectual effort. Students can now generate essays, solve complex mathematical problems, interpret scientific phenomena, and construct convincing arguments within seconds. What previously required substantial investigation and reasoning can increasingly be accomplished through a carefully formulated prompt. While these developments offer unprecedented opportunities for education, they also raise a fundamental concern: Does the ability to produce sophisticated intellectual work necessarily indicate the ability to think critically?

Consider a student who submits a mathematically correct solution but cannot explain why the procedure works, or a university student who presents a coherent scientific argument but struggles to evaluate the evidence supporting it. Such situations illustrate a growing challenge for educational institutions: distinguishing genuine understanding from the appearance of competence.

The crisis of critical thinking in AI-assisted education should not be understood as an established decline in students' intellectual abilities. Rather, it represents an emerging tension between technological efficiency and the educational processes through which independent reasoning develops. The central danger is that educational systems may increasingly reward the quality of AI-assisted outputs without adequately examining the intellectual competence of the individuals producing them.

From Cognitive Assistance to Cognitive Substitution

Critical thinking involves interpreting information, evaluating evidence, identifying assumptions, constructing arguments, considering alternatives, and reflecting on the validity of one's conclusions. These abilities are not acquired simply by observing correct answers. They develop through sustained intellectual engagement, including uncertainty, questioning, reasoning, and the revision of initial judgments.

Technological tools have always influenced how individuals think and learn. Calculators reduce computational demands, search engines facilitate information retrieval, and digital resources extend access to knowledge. Such assistance is not inherently detrimental. Indeed, cognitive offloading, the delegation of certain mental operations to external resources, can free cognitive capacity for more demanding activities (Risko & Gilbert, 2016). However, generative AI introduces a qualitatively different educational challenge. It can perform routine calculations or information retrieval and also activities traditionally regarded as central to higher-order thinking, including constructing arguments, comparing explanations, and generating conclusions. The critical issue is not whether students use external cognitive support, but which cognitive processes they delegate.

When AI performs routine operations, students may have greater opportunities to engage in conceptual reasoning. When it performs the reasoning itself, students may complete an assignment without developing the capabilities the assignment was intended to cultivate. This distinction separates cognitive assistance from cognitive substitution. A student who uses AI to examine alternative mathematical strategies after independently solving a problem may deepen conceptual understanding. In contrast, a student who immediately requests a complete solution and reproduces it without evaluation may demonstrate successful task completion while engaging minimally with the underlying mathematical ideas. Both students may submit equally correct answers, yet their learning experiences are fundamentally different.

What Does the Emerging Evidence Tell Us?

Recent empirical research suggests that the relationship between generative AI and critical thinking is neither uniformly positive nor uniformly negative. Bastani et al. (2025) conducted a field experiment involving nearly 1,000 high school mathematics students. Their findings demonstrated that generative AI assistance substantially improved performance during practice. However, students using an unrestricted AI system subsequently performed worse on independent assessments than those in the control group. Importantly, the negative effects were largely mitigated when the AI tutor was designed to provide guided assistance rather than complete solutions. Although this study examined mathematics learning rather than critical thinking as a separately measured construct, its findings reveal a crucial educational distinction: improved performance during AI-supported activities does not necessarily imply improved independent competence.

Similarly, Lee et al. (2025), in a survey of 319 knowledge workers, reported that greater confidence in generative AI was associated with lower self-reported engagement in critical thinking. Because this study relied on self-reported workplace experiences, it cannot establish that AI causes a deterioration in students' critical-thinking abilities. Nevertheless, it raises important questions about how trust in AI-generated content may influence individuals' willingness to scrutinize information. Other findings point toward potential benefits. In a three-level meta-analysis involving 26 studies, Sun et al. (2026) identified a positive average effect associated with generative AI-supported learning on critical-thinking outcomes. However, substantial heterogeneity shows that these benefits cannot be generalized across all learning environments and instructional approaches.

Furthermore, Cong-Lem and Thuy-Dung (2026), in a scoping review of 29 empirical studies, identified both productive scaffolding and potentially problematic cognitive offloading. Their synthesis emphasized the importance of verification, justification, and active learner engagement.

These findings challenge simplistic claims that AI either destroys or improves critical thinking. Its educational consequences depend on the interaction between technological capabilities, instructional design, learner behavior, and assessment practices. More importantly, the evidence suggests that educators must distinguish three outcomes that are frequently treated as interchangeable: the quality of AI-assisted products, the quality of students' reasoning during AI use, and the competence they retain when AI assistance is unavailable.

The Assessment Paradox: Correct Answers Without Demonstrated Understanding

Perhaps the most significant challenge posed by generative AI concerns the validity of educational assessment. Traditional assessment frequently assumes that a student's completed work provides meaningful evidence of individual knowledge and ability. Although this assumption has never been perfect, generative AI makes it increasingly difficult to sustain without additional evidence.

An accurate solution may not reveal who performed the reasoning. A sophisticated essay may conceal limited understanding of its central argument. A scientifically plausible explanation may be accepted without adequate examination of the assumptions on which it depends. Consequently, correctness alone becomes a less reliable indicator of independent competence. This creates what may be described as an assessment paradox: the more effectively AI assists students in producing high-quality responses, the less confidently educators can infer individual understanding from those responses alone. The solution is not to abandon AI-assisted assessment or to prohibit technological support universally. Instead, educational institutions should reconsider what they assess and what evidence they require.

Three complementary dimensions deserve particular attention. First, independent reasoning concerns students' ability to formulate explanations, solve unfamiliar problems, and justify conclusions without external AI assistance when such independence is an explicit learning objective. Second, AI-assisted reasoning concerns how students interact intellectually with AI-generated content. Do they compare alternatives, question assumptions, evaluate evidence, and revise their reasoning, or do they merely accept the generated response? Third, transfer of learning concerns whether students can apply the understanding developed during AI-supported activities to new problems, contexts, and situations.

These dimensions should not be regarded as an established assessment instrument, but as a practical basis for reconsidering how learning is demonstrated in AI-assisted environments. For instance, students studying quadratic equations might initially solve a problem independently, subsequently compare their approach with an AI-generated solution, and finally explain or solve a different problem without assistance. In science education, students could evaluate competing explanations produced by AI, identify conceptual inaccuracies, and justify their conclusions using relevant scientific principles. Such approaches would help distinguish students' ability to produce answers from their ability to understand, evaluate, and independently reconstruct them.

Critical Thinking Requires More Than Detecting AI Errors

An important emerging assumption is that students can develop critical thinking simply by evaluating AI-generated responses. Although identifying errors, checking sources, and comparing explanations are valuable activities, this perspective contains a potential weakness. Evaluating an explanation requires sufficient knowledge to recognize whether its assumptions, methods, and conclusions are defensible.

Students who lack foundational conceptual understanding may be poorly equipped to identify errors in AI-generated material, particularly when the explanations appear coherent and authoritative. This creates a pedagogical dilemma: Students need critical-thinking skills to evaluate AI, but they also need opportunities to develop these skills without depending excessively on AI.

Therefore, AI literacy cannot substitute for disciplinary knowledge. The ability to formulate effective prompts or identify obvious inaccuracies should not be confused with the capacity to reason deeply about mathematical, scientific, historical, or social problems. Critical thinking requires both domain-specific knowledge and the intellectual disposition to question conclusions, including those presented confidently by intelligent systems. This also has implications for the growing emphasis on verification as a learning strategy. Verification should involve more than consulting another AI-generated response or accepting agreement between different systems. Students must learn to justify conclusions through appropriate evidence, logical analysis, disciplinary methods, and independent judgment.

Reconsidering the Role of Teachers and Educational Institutions

The ways in which AI tools are utilized within the educational environment have contributed to growing interest in their potential to enhance critical thinking skills. Various educational models that foster critical thinking have been developed. These models emphasize the analysis and evaluation of arguments, incorporating the algorithmic and data-driven nature of AI systems (Huda et al., 2022). The interdisciplinary approach enhances critical thinking skills and develops the competencies students need to face the challenges of an increasingly automated society (Spector & Ma, 2019).

The responsibility for preserving critical thinking cannot rest entirely with students. Educational institutions may inadvertently encourage superficial AI use when assessment systems prioritize polished final products, rapid completion, and standardized answers over inquiry and intellectual engagement. If the dominant educational incentive is to produce correct responses efficiently, students may understandably turn to technologies capable of providing those responses almost immediately. The challenge is therefore partly institutional.

Teachers need to design learning environments in which intellectual engagement is not merely encouraged but necessary for successful participation. Students should encounter opportunities to defend their conclusions, challenge competing interpretations, explain unsuccessful attempts, and revise ideas in response to evidence. AI can contribute to these activities when used purposefully. For example, an AI system may act as a Socratic questioner rather than an answer provider, present competing arguments for evaluation, or generate flawed explanations that require critical examination. However, these activities should complement opportunities for students to formulate original ideas and experience the productive difficulties associated with independent problem-solving.

Teacher professional development must consequently move beyond technical competence in AI applications. Educators need support in determining when AI assistance is pedagogically beneficial, when it may undermine learning objectives, and how to obtain credible evidence of students' developing competence. Such principles are consistent with the OECD's (2026) emphasis on distinguishing task performance from genuine learning and UNESCO's (2024) human-centered approach to AI education.

Conclusion: Preserving Intellectual Independence in the Age of AI

The greatest educational challenge posed by generative AI is not simply that machines can generate answers, arguments, and explanations. It is that educational institutions may increasingly struggle to determine whether students have developed the reasoning abilities represented by those outputs. Nevertheless, the available evidence does not support the conclusion that AI inevitably diminishes critical thinking. Under appropriate pedagogical conditions, it may strengthen inquiry, facilitate reflection, and expand opportunities for intellectual development. The responsibility of education is not to resist technological progress but to ensure that the efficiency provided by AI does not come at the expense of intellectual independence. This requires a fundamental reconsideration of teaching and assessment: from evaluating what students can produce with AI toward understanding what they can reason about, justify, and transfer both with and without it.

Ultimately, the success of AI-assisted education should not be measured only by how much better students perform while using intelligent technologies, but also by how much better they can think as a result of using them. Education must ensure that artificial intelligence becomes a means of developing human intelligence rather than a substitute for exercising it.

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