ADAPTIVE AI TUTORS VS. THE TRADITIONAL TEACHER: MEASURING THE IMPACT ON STUDENT AUTONOMY

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Abstract: This article examines the comparative impact of adaptive artificial intelligence (AI) systems and traditional teaching methods on student autonomy and critical thinking. While adaptive AI tutors offer unprecedented personalization and support for self-regulated learning, they introduce risks of cognitive offloading and dependency. The study analyzes how cognitive fatigue and information literacy moderate this relationship. The findings suggest that the most effective model for promoting student agency is a human-centered, blended approach where AI serves as a teacher-enhancement tool.

Keywords: artificial intelligence, adaptive learning, student autonomy, critical thinking, cognitive fatigue, traditional teaching, digital pedagogy.

The introduction of generative artificial intelligence into higher education is changing the nature of the relationship between learner and teacher. Today, with the emergence and proliferation of adaptive intelligent tutoring systems (AITS), traditional teacher-centered instructional systems and standardized assessments are being rethought. These systems demonstrate the ability to model individual learner states. As these technologies become more widespread, the question arises: do the affordability and convenience of artificial intelligence-based personalization truly enhance learner autonomy, or do such technologies foster a new form of cognitive dependency?

These adaptive systems were created to dynamically adjust educational content, pace of learning, and provide methodological support based on continuous data flow. These technologies are primarily based on self-determination theory, and therefore attempt to satisfy fundamental psychological needs for autonomy, competence, and connection. One of the differences between these technologies and traditional learning approaches is that they allow students to track their personal progress and adjust their learning approach as needed, which enhances a sense of personal responsibility.[2]

In the context of STEM subjects, AI tutors have demonstrated impressive learning gains (d = 0.72) compared to standard educational practices. By providing targeted assistance only when needed, AI tutors successfully help to close achievement gaps for some groups of students. These factors create a virtuous cycle of small gains that maintains motivation.[3]

Despite the benefits of new technologies, research in this field warns of "cognitive overload"—the tendency to delegate information processing functions to external tools in order to save mental energy. This tendency can lead to "cognitive inertia," a decline in analytical and reflective thinking.[5, 6]

A study conducted by Jinrui Tian and Ronghua Zhang from Wuhan University has found a negative correlation between critical thinking skills and dependence on artificial intelligence. This correlation is due to the psychological mechanism of cognitive fatigue - a state of mental fatigue characterized by a decrease in attention and a slowdown in the processing of received information

during prolonged mental effort. This fatigue arises from the high costs of monitoring, filtering, and checking required to evaluate information-rich and wide-ranging artificial intelligence responses. When students learn to rely on these tools to conserve mental energy (cognitive unloading), they develop cognitive inertia - a reduced tendency to reflective thinking and analytical analysis. This dependence can lead to a tendency to automatism, where students accept artificial intelligence responses without subjective evaluation, bypassing the process of "detecting inconsistency" and critical analysis, and instead engage in completely independent thinking.Ultimately, this “lazy thinking” compromises intellectual autonomy by distracting students from deep understanding and adapting them to superficial learning, where information is processed superficially without genuine academic engagement.[1]

While adaptive AI systems are better at procedural efficiency and deliver more personalized content, they still lack the conceptual depth that is required to develop true student autonomy.Despite having improvements in certain learning outcomes, traditional educators remain superior in managing the complex intersections of higher-order thinking and social-emotional development. New found evidence increasingly suggests that the most effective teaching model of today is one where educators use AI as a "teacher-enhancement tool" rather than a direct replacement. [2, 4] Human educators provide three critical capabilities that AI systems have not replicated:

First, human educators cultivate critical thinking skills and social adaptation through collaborative learning. Unlike the deterministic nature of AI, teachers provide a collaborative learning environment where students engage with different perspectives and understand ethical reasoning. This interaction is needed for developing a deep understanding of language and culture. AI excels at providing data but only Human Educators can provide context and ethical grounding.

The second factor is emotional support by human educators still remains as a fundamental requirement for effective learning. Education is merely a process of transforming information, it is also a relational process. In a linguodidactic context, a teacher is able to sense a student`s frustration or cultural hesitance and can provide safe environment that AI, which lacks genuine feelings can`t replicate

Finally, the teacher`s role is evolving into one of metacognitive scaffolding. In this role the educator acts as a mentor, guiding students to correctly use AI as a temporary instrument rather than a permanent substitute for a thought. By teaching students to critique AI- generated outputs and to verify its stylistic nuances, the human teacher ensures that technology enhances the student`s intellectual autonomy rather than replacing it. Ultimately, the synergy between human mentorship and technological advancements creates a learning environment where students are active participants rather than a passive consumer of AI generated answers.

Influence of AI on students' autonomy is heavily moderated by information literacy- the ability of a person to evaluate and apply information critically. Students with higher literacy better detect AI hallucinations and biases, resisting automation bias.

However, literacy presents a paradox. While it can protect critical thinking, it simultaneously increases cognitive fatigue because literate students invest more in the verification process of AI generated content. To preserve autonomy in an AI- rich environment, educational systems have to evolve from their simple source evaluation and teach how to manage cognitive load.

The future of student autonomy depends on a “human-in-the-loop” model that integrates both AI technologies and human mentorship. Adaptive tutors are powerful amplifiers of a learning process but they require the presence of a skilled teacher to make sure that efficiency does not come at the cost of students' skills for independent reasoning . To achieve such an educational mode, we need to shift towards a model where AI technologies and human educators co-create learning environments that prioritize transparency, accountability, and long -term cognitive development.

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