

Peer Review

Review of: "Metacognition and Pedagogy in the Era of Artificial Intelligence"

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The article "Metacognition and Pedagogy in the Era of Artificial Intelligence" by Gabriel Goldmeier and collaborators addresses, in a pertinent and urgent manner, the **paradigm crisis** in higher and basic education imposed by the rise of Artificial Intelligence (AI). The central premise is that traditional pedagogical models, focused on content transmission and memorization, have become obsolete in the face of a volatile job market and a society where access to information is instant and ubiquitous. The automation of routine tasks by AI demands a redefinition of essential human competencies.

Effectiveness of Integrating Metacognitive Practices with AI Technologies

The article by Goldmeier et al. integrates metacognition with AI technologies in a **conceptually effective** and **strategically innovative** manner.

- 1. Conceptual Effectiveness:** The article does not view AI as a purely destructive threat to education, but rather as a **catalyst** for pedagogical change. By automating low-level cognitive tasks, AI forces education to focus on what is intrinsically human: **metacognition** (the ability to learn how to learn and to reflect on one's own thinking). This approach transforms AI from a competitor into a **partner** in the development of higher-order skills.
- 2. Strategic Innovation:** The main form of integration proposed is through the use of **Learning Analytics**. Data generated by Virtual Learning Environments (VLEs) and other AI tools are used to provide personalized and systematic feedback to the student, not only on the final result but on the **learning process**. This acts as a digital "mirror," allowing the student and the teacher to monitor and regulate study strategies more consciously and evidence-based.

In summary, the effectiveness lies in using AI's analytical capacity to support and enhance human reflective capacity, which is the essence of metacognition.

Specific Examples of Classroom Implementation (Topic Format)

The implementation of metacognitive strategies in the classroom, supported by AI technologies, can be broken down into the following practical examples:

1. Explicit Teaching of Metacognition

- **Classroom Practice:** The teacher dedicates a short segment of class time (e.g., 10 minutes) to explicitly discuss the three phases of metacognitive regulation: Planning, Monitoring, and Evaluation, before students begin a new project or task.
- **AI Support:** None required. This practice focuses on direct instruction and raising student awareness.

2. Promoting Self-Questioning

- **Classroom Practice:** Before an assessment or study session, the teacher provides a reflective checklist with questions designed to prompt metacognitive thought, such as: "What is the goal of this task?", "Which topics do I master and which do I need to review?", and "Which study strategy worked best last time?".
- **AI Support: Educational Chatbots** can be programmed to interactively pose these reflective questions to the student before they access a study module, ensuring the student consciously engages in self-assessment.

3. Using Learning Analytics for Feedback

- **Classroom Practice:** The educational system tracks student behavior, such as the time spent on different resources (videos, readings, exercises) and performance metrics. The system then generates personalized feedback based on this data.
- **AI Support: Learning Analytics Platforms** provide data dashboards that visualize the student's "digital footprint." This allows the student to receive data-driven feedback, for example: "You spend a lot of time on videos, but your performance improves significantly after reading. Try prioritizing reading."

4. Emphasis on Process over Product

- **Classroom Practice:** For major assignments, students are required to submit a **Metacognitive Logbook** alongside the final product. This logbook documents the strategies used, obstacles encountered, and adjustments made to the initial plan.
- **AI Support: Online Collaboration Tools** (e.g., Google Docs, Miro) allow the teacher to monitor the student's revisions and progress in real-time, enabling continuous assessment of the learning process itself.

5. AI as a Metacognitive Partner

- **Classroom Practice:** A student interacts with an **Intelligent Tutoring System (ITS)**. When the system detects a recurring error pattern, it intervenes not just with a correction, but with a reflective prompt, such as: "What rule are you applying here? Can you explain your reasoning?".
- **AI Support: Intelligent Tutoring Systems (ITS)** use AI to identify knowledge gaps and intervene with targeted, reflective questions that stimulate the student's self-monitoring and evaluation of their own errors.

Declarations

Potential competing interests: No potential competing interests to declare.