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Artificial Intelligence: A Maturity Test. Perspectives on Learning, Teaching, and Assessment

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Abstract: The integration of generative artificial intelligence into education is reshaping the processes of learning, teaching, and assessment. This article analyses the implications of this transformation from four complementary perspectives: (1) the reflexive character of AI as a "mirror" of human thought and the cognitive maturity test it imposes; (2) the restructuring of cognitive processes and the risks of diminished metacognitive engagement; (3) the redefinition of human-specific competences in relation to AI capabilities; and (4) the need for human-centred curriculum design and assessment redesign to support authentic learning. Drawing on recent specialised literature and OECD reports (2025, 2026), the analysis reveals a central tension between the potential for learning personalisation at scale and the risk of the "*mirage of false mastery*" – a phenomenon whereby AI-generated outputs mask the underdevelopment of fundamental competences. The article argues for "pedagogical intentionality" – a deliberate reorientation from AI-driven products toward human-centred processes, prioritising the development of transversal, socio-emotional, and metacognitive competences as a response to the challenges and opportunities of AI in education.

Keywords: artificial intelligence in education, metacognition, transversal competences, socio-emotional competences, self-regulated learning, human-AI collaboration, instructional design

The Problem Context

The diffusion of generative artificial intelligence (GenAI) in educational environments has created an inflection point. The launch of ChatGPT catalysed the adoption of large language models in formal and informal learning contexts – after only two years, in February 2024, in the United States, parents reported that 54% of their 3- to 5-year-old children had already used GenAI for creative activities and 46% for seeking information and advice (Bickham et al., 2024; Kurian, 2025). This penetration of technology into the daily lives of children and young people raises fundamental questions about the nature of learning, the role of the teacher, and the purposes of education.

The OECD Digital Education Outlook 2026 report emphasizes that GenAI tools can support learning when guided by clear teaching objectives or specifically designed for education. However, when AI removes the "**productive struggle**" essential for learning, students may complete tasks faster and achieve better immediate results, but their understanding may be less deeply consolidated (Schleicher, 2026). This empirical observation highlights the need for systematic analysis of how GenAI affects the cognitive, metacognitive, and socio-emotional processes involved in learning.

This article provides a synthesis of the transformations that artificial intelligence brings to education, structured along four thematic axes derived from the specialized literature and recent educational policy documents. The approach is integrative, articulating cognitive, pedagogical, curricular, and evaluative perspectives within a coherent framework accessible to educators in pre-university education.

The analysis is based on a narrative synthesis of the recent specialized literature, integrating reports from international organisations (OECD, UNESCO), empirical studies, and conceptual works from educational sciences, cognitive psychology, and human-computer interaction. The conceptual framework adopts an ecological perspective on learning, recognising the interaction between learner characteristics, the design of the learning environment, the technological tools used, and the broader socio-cultural context. This approach draws on contemporary models of self-regulated learning (Winne & Hadwin, 1998; Zimmerman, 2000) and the paradigm of hybrid human-AI collaboration (Molenaar, 2022, 2024).

1. Artificial Intelligence as a Cognitive Mirror. Epistemological and Pedagogical Implications

The first axis of analysis concerns the fundamentally reflexive character of generative artificial intelligence systems. These systems function, in essence, by returning in a reformulated and synthesized form the information, patterns, and representations contained in the training data. The quality of the output is directly conditioned by the quality of the input – a principle which, transposed to the educational context, implies that the value of student-AI interaction depends on the student's capacity to formulate relevant questions, critically evaluate received responses, and distinguish between valid information and factually erroneous content (so-called algorithmic “hallucinations”).

This characteristic confers upon AI interaction **a dimension of cognitive maturity testing**. As Schleicher (2026) argues, “*students must learn to think before they learn to prompt*”. However, this formulation should not be interpreted as a strict temporal sequence. In a post-digital era where AI is omnipresent, thinking and prompting are increasingly concurrent processes: students will also develop key competences through scaffolded interaction with GenAI, not only prior to it. As Molenaar's (2022) Hybrid Human-AI Regulation model suggests, the relationship between human cognition and AI support is better understood as a collaborative, gradually shifting dynamic rather than a prerequisite-based one. Nonetheless, this observation retains significant pedagogical implications: **the educational use of GenAI presupposes a foundational level of metacognitive and critical thinking competences** that the AI system cannot generate, but can only reflect – amplifying them or, in unfavourable cases, atrophying them.

Harvard Graduate School of Education's “Project Zero”, initiated six decades ago, offers a repertoire of “thinking routines” that invite learners of any age to observe closely, organize their ideas, reason rigorously, and reflect on their own sense-making (Harvard Project Zero, 2025). These methodological tools acquire heightened relevance in the AI context, offering a structured framework for developing the questioning and reflection competences that condition productive technology use.

Accordingly, the integration of AI into teaching should be both preceded and accompanied by explicit activities for developing question-formulation competences. Socratic methods, in which AI is configured to help refine questions rather than provide direct answers, represent a promising approach. Thinking-oriented prompts – for example, “*Suggest questions that would help me better understand topic X*” or “*Ask me questions to clarify my ideas*” – can stimulate deep information processing (Molenaar, 2024).

2. Restructuring Cognitive Processes and the Risk of Diminished Metacognitive Engagement

The second axis of analysis concerns the effects of GenAI on the cognitive and metacognitive processes involved in learning. Recent empirical research has begun to quantify the risks associated with reduced human cognition and metacognition in contexts of intensive AI use (OECD, 2026, p. 52).

The OECD Digital Education Outlook 2026 report identifies a critical risk: the uncritical adoption of GenAI may inadvertently undermine the development of key human skills such as critical thinking, metacognition, and evaluative judgment – all of which are foundational to genuine expertise. This phenomenon has been conceptualized as the “***mirage of false mastery***”, whereby the impressive outputs generated by AI mask the underdevelopment of essential skills, including hybrid human-AI skills (OECD, 2026, p. 57).

The underlying mechanism involves **the reduction of metacognitive engagement** – the self-regulatory mental processes and effort that transform answers into understanding. Metacognition comprises a set of reasoning procedures that operate in the human brain and cross-check thoughts before they are expressed (Veenman et al., 2006). When students rely excessively on AI to obtain answers, this metacognitive engagement decreases, resulting in a dissociation between task performance and authentic learning.

Molenaar (2022) conceptualizes this dynamic within the “Hybrid Human-AI Regulation” (HHAIR) model. AI-based adaptive learning systems can optimize learning based on performance data, but risk taking over (offloading) regulation from the learner. As a result, learners may have fewer opportunities to develop their self-regulated learning skills. The HHAIR model proposes positioning **hybrid regulation as a collaborative task of the learner and the AI, with gradual transfer from AI regulation to self-regulation** (Molenaar, 2022, p. 1).

The study by Tang and colleagues (2024, apud OECD, 2026) demonstrates that structured GenAI feedback on writing tasks can significantly improve the accuracy of students' self-assessment - a key skill for independent learning. However, other studies found that students less experienced with receiving feedback engaged only minimally with a GenAI-based support tool, often due to a mismatch between the tool's responses and their expectations (Jin et al., 2025). These findings suggest that the impact of GenAI feedback depends not only on its technical qualities but also on learners' readiness to interpret and apply it effectively.

Cultivating feedback literacy in a GenAI context requires the explicit development of students' skills in prompt engineering, evaluative judgement, and metacognition, to facilitate deeper and more meaningful interaction with

GenAI in feedback practices (Zhan & Yan, 2025, as cited in OECD, 2026). Teachers can design tasks that require students to compare, critically evaluate, and refine AI-generated responses, transforming passive interaction into active cognitive engagement.

3. Human-Specific Competences

A profound transformation of education requires, as a starting point, the rigorous definition of the problem. What is the greatest difference between AI competences and human competences? Which competences can easily be taken over by AI? The paradoxical answer is that **exactly the competences favoured by "classic" or traditional education – especially numeracy skills and written and oral communication – are those in which AI already performs better or will soon perform better than humans** (OECD, 2025).

The OECD AI Capability Indicators tool (2025) provides a framework for monitoring AI capabilities in relation to human abilities. Drawing on cognitive science, psychometrics, and occupational psychology, the framework identifies core human abilities and correlates them with key AI capabilities. Currently, nine domains are monitored: language, social interaction, problem solving, creativity, metacognition and critical thinking, knowledge, learning and memory, vision, manipulation, and robotic intelligence. This tool enables the identification of areas where humans remain superior and which merit priority educational investment.

The FAB AI Benchmarks initiative (AI-for-Education, 2025) launched the world's first benchmark to test whether large language models "know" pedagogy - that is, whether they can help students learn, not just pass exams. The programme includes four tracks: Pedagogy (testing LLM capacity to pass teacher exams), SEND (special educational needs and disabilities), Visual Maths (elementary visual mathematics), and Visual Reasoning (visual reasoning). The results reveal a significant gap: advanced AI models solve international mathematics olympiad problems almost perfectly but still struggle with elementary visual mathematics problems. The conclusion is that, *for now*, **AI can reproduce knowledge, but it cannot replace the pedagogical expertise of the teacher**.

Kurian (2025) proposes the concept of "Developmentally Aligned Design" (DAD) as a practical and ethical framework for building AI systems that meet children where they are – cognitively, socially, and emotionally. This framework theorizes four complementary principles: (1) perceptual fit – aligning stimulus pacing and resolution with children's evolving sensory bandwidth; (2) cognitive scaffolding – keeping challenges within the zone of proximal development through fine-grained adaptation; (3) interface simplicity – for instance, trimming navigational depth and icon density to respect working-memory limits; and (4) relational integrity – erecting guardrails that prevent parasocial over-attachment or emotional manipulation.

The implications for practice are profound. The set of expected competences of graduates from compulsory education must be reconceptualized to include not only traditional academic competences but also transversal competences (collaboration, communication, critical thinking, problem-solving), psychological dispositions (resilience, curiosity, perseverance, openness), and physical and emotional well-being. As an example, OECD (2025) demonstrates that adults with higher levels of openness to new experiences and emotional stability are more likely to attain higher levels of education and maintain solid literacy, numeracy, and problem-solving skills. **Some of these non-cognitive skills become essential precisely because they cannot be "automated"**.

4. Human-Centred Curriculum Design and Assessment Redesign

Designing a human-centred curriculum in the AI era involves recognizing the growing importance of transversal and non-cognitive competences. Socio-emotional competences – defined as the capacity to synchronize thoughts, emotions, and actions to foster positive interactions within oneself and with others (Hwang et al., 2023) – are recognized as critical both for educational outcomes and long-term well-being.

In a systematic review, Nanda and colleagues (2025) emphasize that socio-emotional learning (SEL) has become a necessary competency for academic success, personal well-being, personality shaping, and future workplace readiness. SEL encompasses the development of self-awareness, self-management, social awareness, relationship skills, and responsible decision-making.

Palmquist and colleagues (2025) argue for integrating socio-emotional competences into AI literacy for education, proposing a framework that equips educators and students with both technological literacy and emotional intelligence. The approach supports a balanced educational environment that promotes cognitive, emotional, and social development, preparing the new generations for a future where digital skills and relational competences are equally valued.

Regarding assessment, OECD (2026) emphasises that teachers should not outsource assessment to AI: "*Algorithms may suggest; teachers must decide*". This principle resonates with the EU AI Act's classification of AI-based assessment as potentially high-risk, which imposes requirements for human oversight, transparency, and accountability (European Parliament & Council. Regulation 2024/ 1689). However, real-time AI-generated feedback can serve multiple functions for improving assessment: engaging students' interest, increasing their understanding of task requirements, reducing degrees of freedom, maintaining direction, marking critical features and discrepancies, modelling solutions, and eliciting articulation and reflection (Wood & al., 1976, apud OECD, 2025).

Hybrid human-AI collaboration in education can take three distinct forms: AI supporting the teacher (e.g., through learning analytics dashboards), AI supporting the student (e.g., through adaptive feedback and personalized learning pathways), and AI mediating collaboration among students (e.g., by facilitating social interaction and group metacognition processes) (Molenaar, 2024). A fourth, increasingly significant form involves AI supporting teachers in learning design and pedagogical resource production – for example, by generating differentiated lesson materials, structuring learning sequences, or suggesting formative assessment strategies aligned with specific learning objectives (Istrate, 2025). In all these configurations, **a core principle remains: AI does not produce active learning – the teacher does**. AI can only amplify: questions, reflection, collaboration, and students' creativity. This is not a claim about technological impossibility – AI systems can, in principle, design tasks that elicit active cognitive engagement. Rather, it is **a claim about pedagogical accountability: learning is fundamentally a social process**, and the deliberate, contextually responsive decisions of a human teacher and the presence of peers remain irreplaceable in ensuring that learning is meaningful, adaptive, and ethically grounded.

Learning analytics provides teachers with unprecedented insight into students' learning processes, enabling understanding of how they apply self-regulation during learning. This information can be used to refine pedagogical practices and design targeted interventions for developing self-regulated learning competences. OECD (2025, Education for Human Flourishing) proposes the concept of "**assessment choreography**" – the development of teachers' capacity to orchestrate multiple assessment modalities into a coherent ensemble that serves both summative and formative functions.

5. Implications

The analysed literature reveals a fundamental tension between the transformative potential of artificial intelligence in education and the risks associated with its uncritical use. On one hand, GenAI offers unprecedented opportunities for learning personalization, immediate and adaptive feedback, and creating more responsive learning environments. However, current evidence suggests that the integration of AI tools does not necessarily reduce working time; rather, it tends to increase productivity and quality of output – a shift that requires deliberate organisational measures and institutional policy to translate into meaningful improvements in teachers' working conditions.

Resolving this tension lies not in rejecting technology, but in cultivating what we might call "**pedagogical intentionality**" – the teacher's capacity to design learning experiences in which AI is strategically integrated to amplify, not substitute, students' cognitive and metacognitive processes. This presupposes a **reorientation from products (AI-generated outputs) toward processes (cognitive engagement, reflection, self-regulation)**. Notably, this reorientation is not a novelty introduced by AI; focusing on learning processes has always been a hallmark of sound pedagogy (International Commission on the Futures of Education, 2021). What AI disruption achieves, paradoxically, is to compel the educational community to re-enact and rediscover these well-established pedagogical principles with renewed urgency.

Chatfield (2025) synthesises this orientation in six principles for human-centred teaching, learning, and assessment with GenAI: (1) doing a task with GenAI isn't the same as learning from it; (2) as machines get smarter, human skills matter more; (3) students must learn to think before they learn to prompt; (4) GenAI works best when teachers design the task; (5) no GenAI lesson plan replaces professional judgment; and (6) algorithms may suggest, teachers must decide. While these principles provide a useful normative orientation, some warrant nuance in practice. In particular, principles (3) and (5) should not be read as strict temporal or categorical separations: in contemporary learning environments, thinking and prompting develop simultaneously, and AI-generated lesson plans may in certain cases surpass individual teacher output in scope or consistency — though the pedagogical value of such plans ultimately depends on the teacher's capacity to adapt, deliver, and contextualise them within a relational and social learning process.

For teachers in pre-university education, practical implications can be structured at three levels:

- At the lesson level: deliberate integration of reflection and self-evaluation moments in activities involving AI; use of thinking-oriented prompts; requiring students to compare, evaluate, and refine AI-generated outputs.
- At the curriculum level: explicit emphasis on transversal and socio-emotional competences; designing authentic tasks that cannot be completed through simple delegation to AI; diversifying assessment modalities. (The AI disruption provides a valuable impetus – and indeed a necessity – for revisiting and redesigning existing syllabuses to align with these priorities. However, implementing authentic, process-oriented tasks at scale requires confronting structural constraints – including overloaded timetables and densely packed curricula – that currently leave limited space for the deeper, more open-ended learning experiences that an AI-augmented pedagogy demands.)
- At the professional development level: continuous engagement in reading about AI, experimenting with its capabilities and limitations, reflecting on one's own pedagogical practice, and collaborating with colleagues to develop effective approaches.

Conclusions

Generative artificial intelligence represents both a profound opportunity and a significant challenge for contemporary education. The path forward is not the rejection of technology, but commitment to pedagogical intentionality and methodological rigor. Rather than simply asking "*does AI increase students' task performance?*", we must focus on **how it can be used to foster deep, meaningful, and durable learning**.

This means reorienting our focus from GenAI-driven products to human-centred processes, ensuring that GenAI tools are designed to scaffold rather than supplant human thinking. By prioritizing the development of durable, transferable skills and integrating metacognitive awareness into both learning and assessment, we can unlock the transformative potential of GenAI, creating an educational future that is not only more efficient but also authentically human (OECD, 2026, p. 57).

Teachers who use AI will not be replaced by AI – but they will transform teaching. Students who learn to use AI as a tool to amplify their own thinking, rather than as a substitute for it, will be prepared for a world where human-machine collaboration becomes the norm, not the exception.

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Note

During the preparation of this article, the authors used Elicit, Gemini, ChatGPT, and Claude to retrieve additional sources, to support the coherence and alignment of the information included, and to find the best formulations of the ideas presented. All AI-generated suggestions were independently selected, verified, and revised by the authors. The authors assume full responsibility for the final content, interpretations, and academic quality of this publication.

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Olimpius Istrate brings over 20 years of experience in digital pedagogy, education programme evaluation, and teacher training. He holds a PhD in education sciences (2011), with a thesis on e-learning programme evaluation. Since 2004, he has taught specialist courses at the University of Bucharest's Faculty of Psychology and Education Sciences, Teacher Training Department – at both bachelor's and master's levels – including Computer-Assisted Instruction, Virtual Learning Environments, New Media in Education and Training, and AI in Education. Currently, Dr. Istrate works as an e-assessment specialist on secondment to the Office of the Secretary-General of the European Schools in Brussels. In the last 20 years, Dr. Istrate has authored several books, chapters, and articles in the field of digital pedagogy, including his influential 2022 paper “Digital Pedagogy: Definition and Conceptual Area”.

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Dr. Oana Barbu-Kleitsch is a university lecturer and researcher in Communication Studies at the West University of Timișoara. Her published research examines advertising and branding from a cultural and critical perspective, with a focus on the symbolic dimension of advertising discourse, the ethics of microtargeting, and the dynamics of identity in digital environments. In parallel, she has participated in multiple projects and professional training programmes dedicated to educational innovation and the development of socio-emotional and digital competences in educational contexts.

François Jourde has a background in teaching (philosophy, secondary level) and teacher training. He works at the Office of the Secretary-General of the European Schools (Brussels) in the fields of digital education and AI governance, learning for sustainability, professional development, and Erasmus+ collaborations. He has contributed as an expert to the European Commission's working groups on AI Ethics in Education and on Learning for Sustainability. Drawing upon a diverse professional trajectory that commenced with a foundational commitment to education, he brings a blend of pedagogical expertise and institutional experience to his current roles. This allows him to bridge the gap between classroom practice, institutional governance, and European policy.