

Cognitive Governance in AI-Mediated Education: A Conceptual Framework for Learner Agency

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Abstract: The integration of artificial intelligence (AI) into education is reshaping learning environments, raising critical questions about the relationship between technological innovation, learner autonomy, and educational oversight. While AI offers significant opportunities for personalization, adaptive support, and pedagogical innovation, its increasing role in automating cognitive processes also raises concerns about cognitive offloading, reduced critical engagement, and the weakening of learner agency. This conceptual paper introduces the notion of cognitive governance, defined as the pedagogical and ethical dimension of educational governance concerned with preserving learner cognitive agency in AI-mediated environments. Drawing on literature on AI in education, metacognition, learner agency, and human-centered pedagogy, the paper proposes the Cognitive Governance Framework, structured around four core dimensions: student-centered learning and cognitive agency protection, governance and human oversight, AI as cognitive scaffold, and educational mediation and human development. To illustrate the framework's practical relevance, the paper discusses the conceptual application of a middle school educational project, Banknote for the Future, in which students used AI-assisted design tools while critically intervening to preserve cultural meaning, creative autonomy, and reflective agency. The discussion argues that effective AI integration in education requires governance models that position technology as a form of intellectual augmentation rather than substitution. The paper concludes that preserving meaningful learner agency in AI-mediated education depends on robust cognitive governance capable of aligning technological innovation with human-centered educational values.

Keywords: artificial intelligence; cognitive governance; cognitive agency; learner agency; AI-mediated learning; educational governance



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1. Introduction

This conceptual paper explores the intersection of artificial intelligence (AI), the evolving role of the human mind, and the structural oversight required to manage these changes in learning environments. The relationship between AI, cognitive agency, and educational governance forms the conceptual basis for what this paper defines as cognitive governance. In this paper, cognitive governance is understood

as the pedagogical and ethical dimension of educational governance specifically concerned with preserving learner cognitive agency in AI-mediated environments.

The integration of AI into the classroom creates a tension between technological efficiency and student cognitive agency. While AI offers significant opportunities for personalization and support, its ability to automate thought processes risks turning learners into passive consumers of algorithmic outputs rather than active thinkers (Ryzheva et al., 2024).

To address this tension, cognitive governance, as a pedagogically oriented dimension of educational governance, must move beyond simple regulation and establish ethical and intentional frameworks that preserve human autonomy in learning. Governance should ensure that AI functions as a “cognitive scaffold” rather than a replacement for human cognition, maintaining the learner as the primary decision-maker in the educational process (Rahman, Watanobe, 2023).

While algorithms can streamline tasks and personalize content delivery, they may also automate cognitive processes essential to learning, contributing to cognitive offloading and reducing opportunities for critical reasoning and curiosity. Clear and ethical frameworks are therefore necessary to ensure that AI remains a co-author of cognition rather than a substitute for it. In this perspective, governance becomes not merely a compliance mechanism, but a relational and intentional structure that protects the critical independence and decision-making power that defines meaningful education (Chan, Hu, 2023).

2. The AI-Agency Tension in Education

2.1. *AI in Education*

AI has become an increasingly significant component of contemporary educational systems, influencing teaching practices, learning environments, and institutional governance (Holmes et al., 2022). Its growing integration is linked to the capacity of intelligent systems to process data, automate repetitive tasks, support decision-making, and create adaptive learning experiences responsive to diverse learner needs (Harry et al., 2023; Igbokwe, 2023; Xu, 2024).

One of the most discussed applications of AI in education concerns personalization (Williamson, 2024). Adaptive learning platforms and intelligent tutoring systems can tailor instructional content, pacing, and feedback according to learners’ profiles, previous performance, and individual learning trajectories (Williamson, 2024). This capacity supports differentiated instruction and may enhance student engagement, accessibility, and academic performance, especially in contexts where educational heterogeneity requires flexible pedagogical responses (Holmes et al., 2022; Selwyn, 2022).

AI also contributes to broader educational innovation by supporting both teaching and educational management (Holmes et al., 2022). Automated grading systems, data-informed assessment, administrative optimization, and intelligent monitoring tools can reduce operational burdens while improving responsiveness and institutional efficiency (Igbokwe, 2023; Xu, 2024). In parallel, AI-based systems may foster inclusion through assistive technologies, multimodal interaction, and

personalized support for students with diverse educational needs, expanding access to learning opportunities (Harry et al., 2023).

At the pedagogical level, AI is increasingly understood as an interactive mediator rather than a simple digital tool (Holmes et al., 2022). Generative AI systems, conversational agents, and intelligent educational platforms can support brainstorming, formative feedback, exploratory learning, and knowledge construction, thereby altering the traditional relationship between student, teacher, and content (Williamson, 2024; Selwyn, 2022). This transformation suggests that AI is not merely an external technological resource, but a factor influencing educational interaction (Selwyn, 2024).

However, the integration of AI into education also raises significant challenges. Ethical concerns include algorithmic bias, data privacy, transparency, accountability, and the risk of unequal access to advanced educational technologies (Eden et al., 2024; Nguyen, 2023). Pedagogically, the increasing reliance on AI-generated outputs may reduce opportunities for active reasoning, critical reflection, and independent problem-solving if learners become passive recipients of automated assistance (Williamson, 2024; Eden et al., 2024; Xu, 2024).

The emergence of generative AI has intensified these debates by challenging conventional understandings of authorship, originality, academic integrity, and the role of human judgment in educational practice (Holmes et al., 2022; Selwyn, 2022). As AI becomes more sophisticated and embedded in everyday learning, the central question is no longer whether AI should be present in education, but how can its integration be governed in ways that preserve human agency, pedagogical intentionality, and meaningful cognitive engagement (Williamson, 2024; Selwyn, 2024).

2.2. *AI, Automation and Cognitive Offloading*

The continuing development of digital technologies and artificial intelligence in educational environments, specifically to support teaching, has brought significant changes in both instructional design and learning experiences. For AI technologies and software to be useful, effective, and properly integrated, it is necessary to consider the underlying cognitive and psychological mechanisms, the potential gap between technologies and students, and the competencies educators themselves must develop for effective implementation.

The relationship between cognitive agency and AI is often framed as a tension between human intentionality and algorithmic automation. A primary concern is cognitive offloading, whereby students delegate reasoning, critical analysis, or creative synthesis to technological systems. If learners use AI merely to generate answers rather than engage in problem-solving, their agency over the thinking process may be weakened (Luckin, 2024).

At the same time, AI can function as a cognitive scaffold that enhances agency rather than diminishing it. It may generate counterarguments, support data organization, and provide immediate feedback, enabling students to self-correct and iterate more efficiently (Selwyn, 2023).

To preserve agency, educational frameworks should emphasize intentionality, critical evaluation, and metacognition (Cukurova, Luckin, Kent, 2020). Students

must remain aware of why they are using AI tools and how such tools affect their understanding.

3. Cognitive Agency as the Core of Learning

The learning process recognizes the abilities of each individual and develops actions aimed at continuous improvement. Learning involves the gradual construction of knowledge, skills, and complex behaviors over time through experience and the development of cognitive structures.

The process of learning inevitably involves the concept of knowledge and, in particular, the role it plays in cognitive processes, as well as the concepts of metaknowledge, or knowledge of the act of knowing, and meta learning, or learning to learn. Both dimensions help students understand how they learn and how they can construct new knowledge. According to Bruner (2005), learning processes occur through specific cultural tools (amplifiers) that allow individuals to develop and enhance their abilities.

In this sense, metacognition is particularly significant, as it expresses a subject's knowledge of their own cognitive functioning and that of others, as well as their awareness of these processes. In carrying out metacognitive activities, the subject resorts to specific functions that vary according to learning phases: before the learning action, planning and forecasting; during the learning action, reasoning; after the learning action, control, transfer, generalization, and maintenance (Albanese, Doudin, Martin, 2002).

During the learning process, it is essential to promote metacognitive awareness and self-knowledge, considering the learner's personality, motivations, learning styles, attribution, and cognitive styles. Taking the metacognitive dimension into account means paying greater attention to how subject content is acquired and learned, that is, "allowing the temporal and mental space to think about the how and not just the what, the process and not just the product" (Carletti, Varani, 2004, p. 296). This influences psychological dimensions of learning such as motivation, self-efficacy, and self-esteem.

Metacognitive work allows learners to understand their own learning characteristics and knowledge-building paths, encouraging autonomy and responsibility in managing their own learning. Through metacognitive activities, learners become consciously involved in active, meaningful, and self-regulated learning (Cera, 2016).

In this perspective, cognitive agency is a central dimension of deep and transformative learning because it shifts the student from passive recipient to active architect of understanding. It represents the learner's intentional capacity to direct mental processes, evaluate evidence, and make autonomous decisions. When students exercise agency, they engage in metacognition, ensuring that knowledge is not merely memorized but integrated into a personal framework of meaning. In contexts where information is increasingly abundant and automated, fostering this critical independence becomes particularly important for meaningful intellectual development (Tomasello, 2024).

It is also important to consider not only the cognitive dimension of learning, but also the emotional-affective and socio-relational dimensions, examining their

impact on cognition (Losito & Pozzo, 2005). Metacognitive processes are therefore highly relevant not only for effective learning, but also for the teaching practices that support intellectual development. In this paper, cognitive agency is treated as a core dimension of learner agency, specifically referring to the learner's capacity for intentional reasoning, metacognitive regulation, and autonomous meaning-making.

4. The Cognitive Governance Framework

4.1. *Student-Centered Learning and Cognitive Agency Protection*

The concept of cognitive agency is deeply embedded in student-centered teaching methods, which promote active learning rather than passive reception, encouraging participation, collaboration, and learner autonomy.

In this sense, inquiry-based learning fosters cognitive agency by shifting the student's role from a consumer of facts to an investigator of problems, while problem-based learning activates agency through engagement with unstructured and challenging situations (Chen, 2022). The resulting learning places the student at the center of the educational process, enhancing knowledge, skills, and autonomy. The objective is to foster learning by doing through experiential yet structured methods that guide students not only to learn, but also to understand in ways that support meaningful achievement.

4.2. *Governance and Human Oversight*

The concept of effective educational governance provides the broader institutional context within which cognitive governance operates. Cognitive governance provides pedagogical and ethical guidance for complex AI-integrated learning environments by balancing innovation with human accountability (OECD, 2026).

Effective governance in modern education moves beyond predefined rules toward relational governance, in which students and teachers collaboratively manage technology use. This approach builds trust and allows learners to critically examine AI limitations rather than merely comply with its outputs. In this perspective, governance ensures that AI functions as a scaffold while keeping the human learner as the ultimate decision-maker, a principle recognized in international frameworks such as UNESCO (2024).

4.3. *AI as Cognitive Scaffold*

AI, like previous communication technologies, can serve as a versatile resource to support educational processes. In school contexts, AI is increasingly integrated into teaching and research because it can reduce operational burdens and support educational innovation (Ruano-Borbalan, 2025).

However, AI should function as a "cognitive scaffold" that encourages learners to move beyond superficial engagement. Cognitive governance connects AI use to broader educational goals, ensuring that generative technologies support higher-order competencies such as interdisciplinary thinking and creative problem-solving. Meaningful learning may be fostered when students critically engage with

technological limitations rather than passively accepting outputs. In this sense, modern education should promote a human-centered mindset in which students understand AI while preserving agency and ethical awareness (UNESCO, 2024).

4.4. Educational Mediation and Human Development

Teaching involves stimulating and facilitating knowledge through strategies that engage logical reasoning, analogical thinking, metacognition, and experiential learning. Sensory perception and emotional dynamics also play a significant role.

An inclusive and innovative educational environment must recognize individual differences and assign importance to cognitive and contextual factors within a multidimensional perspective (Bandura, 2001). This approach moves beyond standardized instruction toward differentiated educational models that allow students to express themselves through multiple learning pathways.

The resulting learning places the student at the center of the educational process, fostering knowledge expansion, skill development, and autonomy. The objective is to support meaningful understanding through structured experiential learning rather than simple content transmission. The conceptual dimensions discussed above can be synthesized in the Cognitive Governance Framework presented in Table 1.

Table 1. Conceptual dimensions of the Cognitive Governance Framework for preserving learner agency in AI-mediated learning.

Dimension	Core Focus	Risk if Absent	Educational Function
Student-Centered Learning and Cognitive Agency Protection	Promotion of active learner participation, autonomy, inquiry, and metacognitive engagement	Passive reception of information, reduced learner autonomy, weakened cognitive agency	Preserves the learner’s role as an active constructor of knowledge
Governance and Human Oversight	Ethical, relational, and accountable regulation of AI integration in educational settings	Uncritical technological dependence, lack of transparency, diminished human decision-making	Ensures that human actors remain responsible for educational choices and AI use
AI as Cognitive Scaffold	Use of AI as a support for reflection, feedback, ideation, and higher-order	Cognitive offloading, superficial engagement, substitution of	Positions AI as an augmentative tool that enhances rather than replaces human

	cognitive processes	independent reasoning	cognition
Educational Mediation and Human Development	Alignment of AI use with pedagogical intentionality, emotional development, inclusion, and differentiated learning	Technocentric instruction, neglect of learner diversity, reduced educational meaning	Maintains a human-centered educational environment oriented toward meaningful development

5. Conceptual Application: Banknote for the Future

To illustrate the practical applicability of the proposed framework, this paper discusses an educational project (“Banknote for the Future”) involving 20 middle school students and three teachers working through an interdisciplinary approach. The project is presented as a conceptual application of the Cognitive Governance Framework, intended to demonstrate how AI-mediated educational activities may support learner agency when guided by intentional pedagogical design and human oversight.

The laboratory teaching approach took the form of project-based work, from the formulation of the project idea to the definition of objectives, the analysis of available resources, the planning of work phases and deadlines, and the final evaluation of results. Experimentation, being primarily cognitive because students continuously organize and reorganize their knowledge through “doing and knowing,” was also supported by emotional engagement, curiosity, and collaborative discovery.

The students explored the intersection of identity, culture, and technology with the support of specific AI software. The project therefore combined AI-assisted ideation with active human personalization.

The project followed a structured pedagogical cycle integrating technological exploration with cultural reflection. The steps below outline how students moved from initial concepts to personalized creation:

- **Conceptualization & Cultural Research:** Students investigated identity, culture, and technological developments, researching historical currency symbols and cultural landmarks connected to their personal or community heritage.
- **AI-Assisted Ideation:** Students used generative AI tools to brainstorm futuristic concepts and visualize technological possibilities for a banknote, generating preliminary layouts and design patterns.

- **Critical Analysis of AI Limitations:** Students compared AI outputs with their original intentions, identifying “decoding” failures in which generic or standardized outputs failed to capture nuanced cultural meanings.
- **Personalized Manual Intervention:** Students modified AI-generated designs by adding hand-drawn symbols, personal signatures, and specific cultural icons that AI could not replicate. This marked the transition from passive use to active intervention.
- **Prototyping & Security Design:** Students added technical features such as security patterns, serial numbers, and fictional anti-counterfeit measures through both digital and physical media.
- **Reflective Presentation:** Students presented their work and explained why they rejected or modified certain AI suggestions, reinforcing reflective awareness and cognitive agency.

While AI was integrated into the creative process, its inability to decode personal and cultural nuances created opportunities for deeper reflection and learner intervention. By recognizing technological limitations, students moved beyond algorithmic outputs to create meaningful personalized artifacts.

The interplay between motivational and creative factors was shaped by the students’ desire for autonomy, competence, and ownership over their work. The project was designed to offer choice and flexibility, enabling students to navigate their own learning paths. Successfully addressing AI limitations may have supported students’ confidence in digital critique and creative problem-solving.

To address the project’s goals of cognitive agency and human-centered design, the most effective teaching methods moved away from direct instruction toward co-constructive and critical approaches. Inquiry-Based Learning (IBL), through the presentation of an open-ended design problem, positioned students as researchers. Critical AI Literacy encouraged them to interrogate AI outputs by asking what had been omitted or misunderstood, preventing cultural flattening into standardized digital aesthetics.

6. Discussion: Implications for Cognitive Governance in Education

The integration of AI into educational environments raises significant implications for the governance of learning processes. If cognitive agency is to remain central, governance cannot be limited to technical regulation or institutional compliance; it must actively support pedagogical intentionality, metacognitive awareness, and human oversight.

The process of learning involves not only knowledge acquisition, but also meta learning and awareness of how knowledge is constructed. In this sense, preserving learner agency requires educational frameworks that emphasize intentionality, critical evaluation, and metacognition (Cukurova, Luckin, Kent, 2020). Students must remain conscious of why they are using AI tools and how these tools shape their understanding.

It is equally important to consider the emotional-affective and socio-relational dimensions of learning, given their impact on cognition (Losito, Pozzo, 2005). Effective governance therefore requires multidimensional educational approaches that recognize learners not simply as users of technological systems, but as developing individuals whose intellectual autonomy must be protected.

The relationship between AI, cognitive agency, and educational governance defines a strategic educational challenge. While AI offers powerful support for personalization and efficiency, its uncritical adoption risks automating thought processes that are essential to learning. Robust cognitive governance is therefore necessary to ensure that AI remains a support for human cognition rather than a substitute for it.

In this perspective, cognitive governance becomes a framework for preserving human-centered learning in technologically mediated environments.

7. Conclusions

The “Banknote for the Future” project illustrates how adaptive technologies and human oversight can coexist within contemporary learning environments. While AI can support personalization and creative exploration, the preservation of cognitive agency depends on robust cognitive governance.

In this project, AI functioned as a cognitive scaffold, providing students with a technological foundation for exploration while leaving space for critical intervention and personalization. Its inability to decode cultural and emotional nuances became a pedagogically meaningful limitation, prompting students to move from passive use toward active engagement.

This transition highlights the central argument of the paper: AI should serve as a form of intellectual augmentation rather than a replacement for human reasoning. Cognitive governance must therefore ensure that learners remain the primary agents in meaning-making, critical thinking, and decision-making processes.

The educational challenges of the AI era require governance models capable of balancing technological efficiency with human autonomy, ethical awareness, and cultural sensitivity. When adaptive systems are accompanied by intentional human oversight, technology can support rather than diminish learner agency.

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