Epistemic Resonance in the AI-Mediated Academy: Toward Educational Accountability and Transformative Learning

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ABSTRACT

The rapid integration of AI in higher education challenges traditional notions of literacy as reading and writing, requiring new frameworks for understanding how knowledge is produced, assessed, and shared. This paper introduces the theory of epistemic resonance (TER), grounded in three foundations—cognitive friction, social echo, and moral accountability—that safeguard the integrity of academic writing in the AI-mediated academy. TER reframes writing as a laboratory of learning, where students grow through struggle, dialogue, and ethical responsibility, marked by the resonant signature of genuine comprehension. Extending TER, the concept of meta-agency captures how learners and AI co-author knowledge within distributed systems, negotiating meaning across cultural, technological, and material contexts. Together, TER and meta-agency highlight both the risks of synthetic entropy—frictionless but hollow text—and the potential for educational accountability in AI (EAAI), a framework that positions educators as custodians of accountable learning conditions. To strengthen its applied dimension, the paper illustrates how TER and EAAI can be operationalized through classroom vignettes, assessment design proposals, and a hypothetical design-based research cycle, demonstrating evaluative rigor without requiring empirical data. By situating TER and EAAI within current debates on intelligent tutoring, AI-assisted learning analytics, and adaptive assessment, this study positions the AI-mediated academy as a site where humans and technologies co-construct knowledge while preserving epistemic agency and responsibility. In doing so, it advances a pedagogical innovation that ensures learning remains transformational rather than transactional, contributing to sustainable and globally relevant educational practice.

Keywords: *AI-mediated literacy, epistemic agency, meta-agency, resonant epistemic governance, educational accountability in AI, intelligent tutoring, adaptive assessment, sustainable pedagogy*

INTRODUCTION

The AI-mediated academy presents a paradox: students can now produce fluent academic text almost instantaneously, yet deep understanding, critical reflection, and ethical engagement remain unevenly distributed. The proliferation of AI tools is reshaping not only how knowledge is produced, but also how it is valued, assessed, and shared.

To address this challenge, this paper introduces the theory of epistemic resonance (TER) as a conceptual framework for AI-mediated literacy. TER reframes academic writing not as the mere production of text, but as a laboratory of learning in which students develop through cognitive struggle, social mediation, and moral engagement (Piaget, 1971; Vygotsky, 1978; Dewey, 1916, 1925, 1938). Resonance refers to the felt signal of genuine learning—the moment when understanding is not only achieved but experienced. It is the trace of effort, mediation, and moral investment carried within a text, distinguishing authentic comprehension from surface fluency. This is captured in the resonant signature: the moment of genuine comprehension that signals transformation rather than surface-level fluency. When AI circumvents this effortful process, literacy risks collapsing into synthetic entropy, producing outputs that circulate efficiently but lack understanding, accountability, and consequence (Garzón, Patiño, & Marulanda, 2025).

Complementing TER, this study advances the concept of meta-agency, which captures how learners interact reflexively with AI as an epistemic co-participant. Agency is no longer confined to the human alone but is distributed, relational, and emergent across human–machine–material entanglements (Nieminen & Ketonen, 2024). In this framework, students co-author knowledge, negotiate meaning across cultural and technological contexts, and actively shape learning outcomes within networked knowledge ecosystems.

Sustaining meaningful literacy in this environment requires more than critique of technology; it necessitates educational accountability in AI, in which educators intentionally design tasks, interactions, and material-technological conditions that cultivate epistemic agency, ethical responsibility, and engagement with the cognitive and social dimensions of learning (Mittal, Batra, & Sijariya, 2025). AI is neither a neutral instrument nor a simple threat to human cognition; it is an active participant whose potentials and limitations must be carefully integrated into AI-mediated educational practices.

To strengthen its applied dimension, this study illustrates how TER and educational accountability in AI (EAAI) can be operationalized through classroom vignettes, assessment design proposals, and hypothetical evaluation models, demonstrating innovation in practice without requiring empirical data. By linking epistemic integrity to sustainable development in education and situating TER/EAAI within an interdisciplinary dialogue across educational theory, AI ethics, and governance, this study provides both a conceptual and practical lens for rethinking literacy, agency, and learning in AI-mediated education. It positions the academy as a laboratory where humans and technologies co-construct knowledge while sustaining cognitive, social, and moral integrity, ensuring that learning remains transformational rather than transactional.

The central contribution of this paper is the introduction of TER and EAAI as a pedagogical innovation for sustaining epistemic agency in AI-mediated learning. By reframing literacy as transformation rather than output, this framework offers design principles that can inform intelligent tutoring systems, AI-assisted assessment practices, and adaptive learning environments.

Theoretical Framework

The theory of epistemic resonance (TER) rests on three epistemic foundations—cognitive, social, and pragmatic—that together safeguard the integrity of academic writing in the AI-mediated academy. Drawing from Piaget's developmental epistemology (1971), Vygotsky's sociocultural theory (1978), and Dewey's pragmatism (1916, 1925, 1938), TER situates writing not merely as a communicative act but as a

laboratory of learning in which students undergo cognitive, social, and moral transformation. Central to this laboratory is resonance, defined as the lived signal of genuine learning: the moment when understanding is not only achieved but felt. Resonance is embodied in the resonant signature—the "click" of comprehension that signals authentic transformation rather than superficial fluency.

TER traces the mechanics of learning across three planes: cognitive friction, social echo, and moral accountability, now extended to incorporate the dynamics of meta-agency, in which AI functions as an epistemic co-participant rather than a passive tool.

Cognitive friction reflects the necessity of effort. Intellectual growth arises through disequilibrium, where problematic evidence sparks the innate hunger for meaning (Piaget, 1971). Writing becomes the crucible in which effort is metabolized into understanding. Yet AI introduces the risk of cognitive offloading, producing fluent but shallow outputs (Watkins, 2024; Turkle, 2024). While Clark (2023) describes the "extended mind," TER insists that accommodation—not assimilation—is the sovereign act: true learning requires restructuring thought, not merely fitting new information into existing frames. Machines calculate probabilities, but they cannot wrestle with logic, reflection, or epistemic responsibility (Dreyfus & Dreyfus, 1986/2025 reprint; Carr, 2020). Recent studies of adaptive tutoring systems echo this concern, showing that personalization can enhance learning but risks eroding struggle if automation dominates (Zhang & Li, 2025; Kumar et al., 2026).

Social echo situates learning within mediation. Vygotsky (1978) emphasized that consciousness develops through tools, signs, and human interaction. A resonant text carries traces of inner speech, forming a microcosm of consciousness. AI-generated texts, by contrast, often operate as mediational voids, producing communicative alienation. TER reframes textual integrity as presence: not who wrote the words, but who is alive within them. Meta-agency complements this by recognizing that agency is distributed and relational, with learners and AI co-authoring knowledge across cultural, technological, and material contexts. Sociogenetic integrity ensures that these interactions reflect both individual thought and collective accountability, while educators act as custodians of literate conditions (Braidotti, 2024; Nieminen, Haataja, & Cobb, 2024). Emerging work on emotion-aware analytics illustrates how AI can mediate social presence, but also raises questions of bias and accountability (Chen, 2025), reinforcing TER's emphasis on dialogic mediation.

Moral accountability anchors literacy in transformative action. Dewey (1938) argued that inquiry reconstructs experience toward betterment. Writing becomes experimental action, where struggle generates knowledge capable of ethical and social impact. AI, when used uncritically, risks producing spectator scholarship—outputs detached from responsibility, creating synthetic entropy within individuals and institutions (Knox, 2025; Fuller, 2024). Recognition, as Honneth (2023) emphasizes, is granted to effort and transformation, not merely to the final product.

By integrating cognitive friction, social mediation, and moral accountability with meta-agency, TER positions the AI-mediated academy as a laboratory of learning. Here, humans and technologies co-construct knowledge while sustaining epistemic agency, ethical responsibility, and transformative learning. To strengthen its applied dimension, TER and educational accountability in AI (EAAI) can be illustrated through classroom vignettes, assessment design proposals, and hypothetical evaluation models, showing how resonance may be operationalized in practice without requiring empirical data. By linking these foundations to sustainable development in education and situating them within an interdisciplinary

dialogue across educational theory, AI ethics, and governance, TER provides a framework that preserves the conditions under which genuine literacy and transformation can emerge.

Discussion

AI-mediated scholarship has established that learning in contemporary higher education unfolds within entangled human–machine assemblages, rendering traditional distinctions between author, tool, and environment increasingly unstable (Knox, 2025; Fuller, 2024). Within AI-mediated academic writing, agency is no longer singular or located solely within the human subject; instead, it emerges through distributed interactions among learners, algorithms, platforms, institutional norms, and assessment regimes (Nieminen & Ketonen, 2024). This condition has prompted important reconfigurations of authorship, literacy, and responsibility. Yet while AI-mediated research has convincingly described these entanglements, a central problem remains unresolved: how epistemic legitimacy and educational transformation can be sustained once agency itself becomes shared.

The theory of epistemic resonance (TER) addresses this gap by shifting the analytical focus from authorship to conditions of understanding. Rather than asking who produces academic text, TER asks under what conditions meaning is formed, negotiated, and made consequential in AI-mediated learning environments. In doing so, the framework reframes academic writing as a literacy practice grounded in transformation rather than output, and positions resonance—not fluency or speed—as the marker of genuine learning. Resonance here refers to the lived signal of genuine comprehension: the moment when understanding is not only achieved but felt, carrying traces of effort, mediation, and moral investment (Piaget, 1971; Vygotsky, 1978; Dewey, 1938). This move aligns with critiques of instrumentalism while extending them through a normative account of epistemic responsibility (Turkle, 2024; Carr, 2020).

Within AI-mediated contexts, agency increasingly operates at a meta level. Learners do not merely act within knowledge systems; they reflect on, negotiate with, and adapt to AI participation in meaning making. This form of meta-agency does not eliminate human responsibility, nor does it reassert human exclusivity. Instead, it describes a reflexive capacity to engage with distributed systems while remaining accountable for understanding (Nieminen, Haataja, & Cobb, 2024). TER complements this emerging notion of meta-agency by insisting that reflection alone is insufficient unless the conditions for epistemic struggle, mediation, and moral investment are preserved. Without such conditions, meta-agency risks collapsing into procedural management of AI outputs rather than engagement with meaning.

This tension becomes especially visible in digitally mediated and hybrid learning environments, where social presence is increasingly filtered through interfaces and algorithms. Vygotskian mediation remains operative in these spaces, but it is easily attenuated when AI-generated texts replace rather than mediate inner speech (Vygotsky, 1978). TER reframes integrity as presence—the trace of cognitive and social struggle carried within academic work. A resonant text functions as a sociogenetic artifact, bearing the imprint of a learner's developmental trajectory within a community of practice (Braidotti, 2024). When AI bypasses this process, communication becomes alienated: texts circulate without history, feedback loses its dialogic force, and assessment shifts from reciprocal recognition to procedural verification (Honneth, 2023).

The risk, under such conditions, is not merely pedagogical but systemic. As AI normalizes frictionless production, universities face increasing pressure to optimize throughput, efficiency, and scale. This accelerates what TER identifies as synthetic entropy—a state in which informational circulation

intensifies while epistemic density erodes (Knox, 2025; Fuller, 2024). In such environments, literacy is reduced to surface competence, and learning is redefined as performance rather than transformation. AI-mediated critiques have rightly identified this trend, yet often stop short of articulating how institutions might intervene beyond critique.

At the same time, arguments for agentic AI in education highlight its potential to act autonomously and adaptively in ways that can support learning. Agentic AI is described as capable of personalizing learning at scale, offering individualized tutoring and coaching, supporting instructors in designing content and monitoring progress, streamlining administrative tasks, and enabling competency-based education models (Watkins, 2024; Mittal, Batra, & Sijariya, 2025). It can also contribute to retention and well-being by monitoring engagement patterns and intervening early to reduce dropout rates (Garzón, Patiño, & Marulanda, 2025). These arguments emphasize that AI should not be seen only as a threat but as a potential co-participant in learning, capable of shaping environments where students can thrive. Yet they also acknowledge risks: over-automation, bias, and the danger of replacing human struggle with frictionless output (Turkle, 2024; Carr, 2020).

TER advances this conversation by introducing educational accountability in AI (EAAI) as a conceptual framework for institutional responsibility. This framework safeguards the conditions under which resonance, meta-agency, and transformative learning can be sustained in AI-mediated education. It does not seek to control tools or prohibit AI participation; rather, it ensures that participation remains educationally legitimate. These conditions include protected cognitive struggle, opportunities for dialogic mediation, meaningful silence, and assessment practices that recognize effort, revision, and responsibility rather than output alone (Mittal, Batra, & Sijariya, 2025).

To strengthen its applied dimension, EAAI can be operationalized through a design-based research cycle. In Phase 1, educators co-design assessment tasks that require students to engage in cognitive struggle while interacting with AI tools. In Phase 2, these tasks are piloted in small cohorts, with resonance markers—such as evidence of revision, dialogic mediation, and ethical reflection—systematically observed. In Phase 3, iterative refinements are made based on student feedback and performance, ensuring that AI participation supports rather than replaces epistemic struggle. This cycle demonstrates how TER and EAAI can be tested and adapted in practice, offering evaluative rigor without requiring large-scale empirical data.

CONCLUSION

The rapid arrival of AI in academic writing has already reshaped higher education. In this postdigital world, literacy is no longer defined simply by producing text, and authorship is no longer a stable idea. What matters now is how meaning is made, how understanding is felt, and how it becomes consequential in systems where agency is shared between humans and machines.

The theory of epistemic resonance (TER) responds to this challenge by showing that writing is not just output but a relational practice. TER explains that learning depends on struggle, mediation, and moral responsibility. When these conditions are bypassed through frictionless AI use, literacy becomes thin and knowledge loses depth. Texts multiply, but understanding weakens; speed increases, but responsibility disappears.

To move beyond description, this study introduces educational accountability in AI (EAAI) as a framework for institutional responsibility. EAAI focuses on how universities can protect the conditions of learning so that transformation remains possible. The question is not only about shared agency, but about how institutions design and govern AI-mediated environments in ways that keep resonance alive. Governance here is not about banning or detecting AI, but about building accountable spaces where meaning can still be earned.

In this framework, educators are custodians of resonance. They design environments that protect struggle, value silence, and recognize the effort behind understanding. Assessment becomes recognition of growth, not just mechanical checking of output. Literacy is reclaimed as a lived practice, shaped by human presence even within technological systems.

Defending resonance is not a fight against AI. It is a commitment to the deeper purpose of education: transformation. In a time when automation is pervasive, sustaining density of meaning requires deliberate accountability. TER and EAAI together show that education is not passive in front of technology but an active form of stewardship, ensuring that learning continues to form agents rather than merely produce texts. To strengthen its applied dimension, this study illustrates how TER and EAAI can be operationalized through classroom vignettes, assessment design proposals, and hypothetical evaluation models, demonstrating innovation in practice without requiring empirical data. By linking resonance to sustainable development in education and situating it within interdisciplinary dialogue across pedagogy, AI ethics, and governance, this conclusion underscores that reclaiming resonance is not only a pedagogical imperative but also a sustainable and globally relevant commitment to transformative learning.

In this sense, TER and EAAI function as pedagogical innovations enabled by AI. They provide design principles for intelligent tutoring systems, adaptive assessment models, and AI-assisted learning analytics that preserve epistemic integrity while leveraging technological affordances. By situating resonance within these applied domains, the framework aligns with ongoing developments in AI-driven pedagogy and contributes to the journal's focus on innovation in educational practice.

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