

Pedagogical Co-Agency in the Age of Generative AI: From Chalkboard to ChatGPT

UDC 37.014:004.8

DOI: <https://doi.org/10.15421/172653>**Hasanova Aygun¹**Senior Teacher, <https://orcid.org/0000-0002-0112-5257>, aygun.hasanova@adau.edu.az**Humbetova Ayten²**Ph.D., <https://orcid.org/0000-0001-6325-8197>, aytenbdu@yahoo.com**Aydinova Sakina²**Ph.D. Student, <https://orcid.org/0000-0001-6126-5617>, sakinaaydinova@yahoo.com**Mahmudova Sevinc¹**Senior Teacher, <https://orcid.org/0000-0001-7690-7184>, sevinc.020ss@gmail.com¹*Azerbaijan State Agricultural University (Ganja, Azerbaijan)*²*Baku State University (Baku, Azerbaijan)*

Abstract.

The rapid transition from chalkboard-centered instruction to generative artificial intelligence-supported learning environments marks not merely a technological shift, but an epistemological rupture in the history of education. This article critically interrogates the pedagogical, cognitive, and ethical implications of integrating large language models—particularly ChatGPT developed by OpenAI—into formal and informal learning contexts. Rather than adopting a celebratory or alarmist stance, the study positions generative AI as a transformative mediating artifact that reconfigures knowledge production, authorship, assessment, and academic integrity.

Drawing upon socio-constructivist theory (Vygotsky), critical pedagogy (Freire), and postdigital educational frameworks (Jandrić), the paper develops a multi-layered conceptual model termed Pedagogical Co-Agency, which conceptualizes AI not as a tool or substitute teacher, but as a cognitive collaborator operating within dynamic human-machine assemblages. Through qualitative discourse analysis of policy documents, higher education syllabi, and classroom narratives across secondary and tertiary contexts, the study identifies three emergent paradigms: (1) algorithmic scaffolding, (2) distributed cognition, and (3) epistemic outsourcing. These paradigms illuminate both productive affordances – enhanced feedback loops, adaptive explanation, democratized access to expertise—and structural risks, including epistemic homogenization, shallow learning patterns, and the erosion of authorial responsibility.

The findings suggest that the uncritical incorporation of generative AI into curricula accelerates what is termed cognitive automation dependency, a condition in which learners increasingly externalize metacognitive labor to algorithmic systems. However, when embedded within critically designed pedagogical frameworks emphasizing reflexivity, transparency, and dialogic engagement, AI-mediated learning can deepen conceptual understanding and foster higher-order thinking.

Keywords: Generative Artificial Intelligence, Pedagogical Co-Agency, Epistemic Outsourcing, Cognitive Automation Dependency, Hybrid Authorship, AI in Higher Education, Mediated Cognition, Postdigital Learning Environments

Педагогічне співробітництво в епоху генеративного ШІ: від Chalkboard до ChatGPT

Хасанова Айгун¹, Гумбетова Айтен², Айдінова Сакіна², Махмудова Севінч¹¹*Азербайджанський державний сільськогосподарський університет (Гянджа, Азербайджан)*²*Бакинський державний університет (Баку, Азербайджан)*

Анотація.

Швидкий перехід від навчання, орієнтованого на дошку, до навчальних середовищ із підтримкою генеративного штучного інтелекту, позначає не лише технологічний зсув, а й епістемологічний розрив в історії освіти. У цій статті критично розглядаються педагогічні, когнітивні та етичні наслідки інтеграції великих мовних моделей – особливо ChatGPT, розробленого OpenAI – у формальний і неформальний навчальний контекст. Замість того, щоб займати святкову або тривожну позицію, дослідження позиціонує генеративний ШІ як трансформаційний посередницький артефакт, що переконфігурує виробництво знань, авторство, оцінювання та академічну цілісність.

Спираючись на соціоконструктивістську теорію (Виготський), критичну педагогіку (Фрейре) та постцифрові освітні рамки (Яндріч), у статті розробляється багатшарова концептуальна модель під назвою Педагогічне співагенство, яка концептуалізує ШІ не як інструмент чи заміника вчителя, а як когнітивного колаборанта, що діє в динамічних асамбляжах людини-машина. Завдяки якісному дискурсивному аналізу політичних документів, навчальних програм вищої освіти та класних наратив у середніх і третинних контекстах, дослідження визначає три емерджентні парадигми: (1) алгоритмічне підкріплення, (2) розподілене пізнання та (3) епістемічне аутсорсинг. Ці парадигми висвітлюють як продуктивні можливості – посилені цикли зворотного зв'язку, адаптивне пояснення, демократизований доступ до експертизи – так і структурні ризики, включно з епістемічною уніфікованістю, поверхневими навчальними патернами та ерозією авторської відповідальності.

Результати свідчать, що некритичне впровадження генеративного ШІ в навчальні програми прискорює так звану залежність від когнітивної автоматизації – стан, за якого учні дедалі більше зовнішньо передають метакогнітивну працю алгоритмічним системам. Однак, коли навчання під керівництвом ШІ інтегрується у критично спроектовані педагогічні рамки, що підкреслюють рефлексивність, прозорість і діалогічну взаємодію, навчання під керівництвом ШІ може поглибити концептуальне розуміння та сприяти мисленню вищого порядку.

Ключові слова: генеративний штучний інтелект, педагогічна співагенція, епістемічний аутсорсинг, залежність від когнітивної автоматизації, гібридне авторство, штучний інтелект у вищій освіті, опосередковане пізнання, постцифрові навчальні середовища

Стаття надійшла / Article arrived: 12.01.2026 // Схвалено до друку / Accepted: 01.03.2026 // Підписано до друку / Approved for printing: 04.03.2026

Introduction.

For centuries, the chalkboard symbolized the structure of formal education: a visible surface upon which knowledge was transmitted, negotiated, and stabilized within the bounded space of the classroom. Even as digital technologies entered schools and universities, the epistemic architecture of teaching remained largely human-centered. The instructor curated content, structured dialogue, and validated knowledge claims. Learning was tied to observable intellectual labor—drafting, calculating, revising, and arguing in ways that could be traced to individual cognitive effort.

The emergence of generative artificial intelligence (GenAI), particularly large language models such as ChatGPT developed by OpenAI, represents a qualitatively different transformation. Unlike earlier digital tools that stored or delivered information, generative AI systems produce context-sensitive responses in real time. They simulate dialogue, generate essays, summarize research, solve problems, and provide adaptive feedback within seconds. This shift moves AI from the periphery of educational technology into the center of epistemic activity.

Analysis of previous studies. Recent scholarship confirms the scale and speed of this transformation. Systematic reviews of generative AI in higher education identify rapid adoption across disciplines, highlighting applications in writing support, assessment design, feedback generation, and personalized learning (Kasneci et al., 2023; Zawacki-Richter et al., 2023). Empirical analyses published in leading educational technology journals demonstrate both measurable learning gains and significant concerns regarding overreliance, superficial engagement, and assessment validity (Baidoo-Anu & Ansah, 2023; Cotton et al., 2024). Moreover, large-scale institutional surveys indicate that the majority of university students now use generative AI tools in some form during their academic work, prompting urgent policy reconsiderations regarding integrity and evaluation frameworks (HEPI, 2025).

Despite this growing body of research, the existing literature remains conceptually fragmented. Many studies focus on performance outcomes—improvements in grammar, efficiency, or task completion—without interrogating deeper epistemic consequences. Others emphasize ethical risks such as plagiarism or misinformation but do not sufficiently theorize how AI reshapes the distribution of cognitive labor. As a result, the field risks oscillating between techno-optimism and techno-pessimism without articulating a coherent conceptual model of human–AI educational interaction.

1. Results.

To address this gap, it is necessary to move beyond instrumental questions—“How can AI improve learning outcomes?”—and instead examine structural transformations in knowledge production. From a socio-cultural perspective, learning has long been understood

as mediated action (Vygotsky, 1978), shaped by tools that reorganize cognition. Critical pedagogy further reminds us that knowledge production is inseparable from questions of agency and power (Freire, 1970). In the postdigital condition, where boundaries between human and technological actors blur (Jandrić et al., 2018), generative AI must be analyzed not merely as a tool but as a participant in epistemic processes.

The transition from chalkboard-centered instruction to AI-mediated dialogue therefore signals an ontological and epistemological shift. Authorship becomes hybrid. Intellectual labor becomes partially externalized. Feedback becomes instantaneous and algorithmically generated. In such conditions, conventional assumptions about originality, mastery, and assessment require re-examination. If students increasingly collaborate with generative systems in drafting arguments or solving complex tasks, how should educators interpret authorship and evaluate understanding?

At the same time, dismissing generative AI as inherently detrimental would overlook its genuine pedagogical affordances. Studies indicate that when used reflectively, AI systems can scaffold novice learners, support multilingual students, and facilitate iterative feedback loops that enhance conceptual clarity (Kasneci et al., 2023). The issue, therefore, is not the mere presence of AI, but the absence of a robust theoretical framework capable of distinguishing productive co-agency from passive cognitive outsourcing.

This article adopts a conceptual-analytical approach to interrogate the deeper transformation initiated by generative AI in education. Rather than assessing isolated classroom interventions, it seeks to theorize the reconfiguration of authorship, cognitive distribution, and pedagogical responsibility in AI-augmented learning environments.

Accordingly, this study addresses the following research questions:

- RQ1. How does the emergence of generative AI reconfigure the ontological status of authorship and knowledge production within formal education?
- RQ2. In what ways does AI-mediated learning redistribute cognitive and metacognitive agency between human learners and algorithmic systems?
- RQ3. What forms of epistemic outsourcing and cognitive automation dependency emerge in AI-augmented classrooms?
- RQ4. How can a normative framework of pedagogical co-agency be conceptually constructed to preserve intellectual accountability in hybrid human–AI learning environments?

By articulating these questions, the article aims to contribute a theoretically grounded model that moves beyond polarized debates and offers a coherent conceptual vocabulary for understanding the transition from chalkboard pedagogy to AI-mediated education.

2. Theoretical Framework.

The rapid institutionalization of generative artificial intelligence in education demands more than pragmatic adaptation; it requires theoretical clarification. Without a coherent conceptual grounding, analyses of AI in classrooms risk remaining either technologically deterministic or normatively reactive. This section situates the present study within three interrelated theoretical traditions—mediated cognition, critical pedagogy, and postdigital theory—in order to construct a rigorous foundation for the concepts of epistemic outsourcing, cognitive automation dependency, and pedagogical co-agency. By integrating these traditions with recent 2022–2025 scholarship on generative AI in education, the framework establishes the analytical legitimacy of the proposed model.

2.1 Learning as Mediated Action in Algorithmic Contexts.

Socio-cultural theory has long maintained that cognition is not an isolated mental process but a mediated activity shaped by cultural tools (Vygotsky, 1978). Writing, diagrams, symbolic systems, and digital platforms function not merely as supports but as cognitive reorganizers. Tools do not simply extend thinking; they restructure it. From this perspective, generative AI must be understood as a mediational artifact of unprecedented complexity.

Recent empirical research confirms that large language models influence not only task completion speed but also problem-framing strategies and argumentative structure (Kasneci et al., 2023; Cotton et al., 2024). Studies published in *Computers & Education* and *Educational Technology Research and Development* show that students interacting with AI-based writing assistants tend to reorganize planning phases, rely on iterative prompt refinement, and externalize drafting processes that were previously internal cognitive operations (Zawacki-Richter et al., 2023; Baidoo-Anu & Ansah, 2023).

This shift marks a qualitative intensification of mediated cognition. Whereas earlier digital tools supported discrete stages of learning (e.g., spell-checking or content retrieval), generative AI intervenes directly in generative thought. It proposes arguments, synthesizes literature, and constructs explanatory narratives. The mediational role thus moves from supportive scaffold to co-productive participant.

Within this transformed ecology, I introduce the concept of epistemic outsourcing: the structured delegation of knowledge-generative processes from human cognition to algorithmic systems. Unlike simple tool use, epistemic outsourcing entails the partial displacement of inferential labor. It becomes visible when learners accept AI-generated formulations as epistemically sufficient without re-engaging critically with underlying reasoning. Emerging 2024 studies on AI-assisted academic writing note patterns of reduced revision depth and diminished metacognitive reflection when AI output is adopted with minimal interrogation

(Cotton et al., 2024). These findings align with concerns that generative AI may reconfigure—not eliminate, but redistribute—cognitive effort.

However, mediated cognition theory cautions against technological determinism. Tools shape action, yet human agency remains decisive. Thus, epistemic outsourcing should be conceptualized as a spectrum rather than a binary condition, contingent on pedagogical design and user reflexivity.

2.2 Authorship, Power, and Epistemic Authority.

If mediated action addresses cognitive redistribution, critical pedagogy foregrounds questions of authorship and power. For Freire (1970), authentic learning requires dialogic engagement in which learners become producers—not passive recipients—of knowledge. Generative AI complicates this dialogic structure. When a student co-constructs a text with an algorithmic system, authorship becomes hybrid, and the locus of epistemic authority becomes diffuse.

Recent debates in higher education policy literature emphasize that generative AI challenges traditional understandings of originality and academic integrity (Eaton, 2023; HEPI, 2025). Yet many institutional responses remain procedural—focusing on detection technologies or disclosure requirements—rather than philosophical. The deeper issue concerns what constitutes intellectual ownership in environments where algorithmic systems contribute syntactic and semantic structuring.

Here, we introduce the concept of cognitive automation dependency: a condition in which learners habituate to algorithmic generation to such an extent that productive cognitive struggle diminishes. Unlike efficiency gains, which may be pedagogically beneficial, automation dependency reflects a gradual erosion of epistemic resilience—the capacity to sustain analytical reasoning without algorithmic supplementation.

Evidence from 2023–2025 classroom studies suggests mixed outcomes. While AI-supported learners often demonstrate improved surface coherence in writing, some studies report weaker argumentative depth and reduced independent synthesis when AI use is unstructured (Kasneci et al., 2023; Cotton et al., 2024). These findings do not imply cognitive decline but indicate the necessity of re-theorizing intellectual accountability in AI-mediated contexts.

Critical pedagogy therefore becomes indispensable. If power operates through control of discourse, then AI systems—trained on vast corpora reflecting dominant linguistic and cultural patterns—may subtly standardize expression. Post-2022 analyses of language model bias emphasize the reproduction of hegemonic norms embedded in training data (Bender et al., 2021; further elaborated in 2023 AI ethics scholarship). Consequently, AI integration must be assessed not only for efficiency but for epistemic justice.

2.3 Postdigital Co-Agency and Hybrid Cognition.

The postdigital perspective rejects simplistic binaries

between human and technological actors. As Jandrić et al. (2018) argue, contemporary educational spaces are hybrid assemblages in which digital and analog, human and machine, coexist in dynamic entanglement. Generative AI intensifies this entanglement by simulating dialogic interaction.

Recent 2024–2025 theoretical contributions in postdigital education emphasize that AI should be analyzed as part of distributed cognitive networks rather than as an isolated tool (Knox, 2024; Selwyn, 2024). These analyses suggest that educational agency increasingly operates across human–machine constellations. Learning becomes a relational process embedded in algorithmically mediated infrastructures. Building on this perspective, I propose the concept of pedagogical co-agency: a normative and analytical model describing structured collaboration between human learners and AI systems within clearly defined epistemic boundaries. Pedagogical co-agency differs from passive outsourcing in three ways.

1. Transparency – AI contributions are acknowledged and critically examined.
2. Reflexivity – learners evaluate and revise algorithmic output rather than accepting it uncritically.
3. Accountability – assessment frameworks prioritize reasoning processes over polished surface products.

The concept is theoretically grounded in distributed cognition theory (Hutchins, 1995) and reinforced by contemporary AI-in-education scholarship emphasizing guided integration rather than prohibition (Zawacki-Richter et al., 2023; Kasneci et al., 2023). It seeks to reconcile mediated cognition with critical pedagogy by recognizing AI as a participant in epistemic processes while preserving human interpretive sovereignty.

2.4 Toward a Conceptually Integrated Model.

Integrating these strands, the theoretical framework establishes four core propositions.

1. Generative AI functions as a high-intensity mediational artifact that reorganizes cognitive processes.
2. The redistribution of inferential labor produces identifiable forms of epistemic outsourcing.
3. Without critical structuring, sustained AI reliance may foster cognitive automation dependency.
4. A normative model of pedagogical co-agency can align AI integration with deep learning and intellectual accountability.

By grounding newly introduced concepts in established socio-cultural, critical, and postdigital traditions—while integrating findings from 2022–2025 empirical AI research—this framework provides the analytical foundation necessary to move beyond polarized discourse. The following section builds upon this foundation to articulate a structured conceptual model of pedagogical co-agency applicable to AI-augmented educational environments.

3. Conceptual Model: Pedagogical Co-Agency.

Building on the theoretical foundations outlined in

the previous section, this study proposes a Conceptual Model of Pedagogical Co-Agency for AI-augmented learning environments. The model conceptualizes generative AI not merely as a digital tool but as a cognitive partner whose participation can be modulated through pedagogical design, institutional policy, and learner reflexivity. It integrates insights from mediated cognition, critical pedagogy, and postdigital theory to provide a structured framework for understanding, evaluating, and guiding AI-human interaction in education.

3.1 From Tool Use to Epistemic Partnership.

Traditional educational technology research has largely treated AI as a tool, a passive instrument to be deployed for specific tasks such as essay drafting or feedback generation (Zawacki-Richter et al., 2023). However, generative AI's capabilities extend beyond retrieval and procedural support; it actively participates in meaning-making, generating arguments, synthesizing sources, and suggesting problem-solving pathways.

In the model, this shift is represented as a continuum from instrumental use to epistemic partnership, where learners engage with AI as co-constructors of knowledge. Empirical studies (Kasneci et al., 2023; Cotton et al., 2024) demonstrate that such engagement enhances certain learning outcomes—particularly the breadth of argumentation and exposure to multiple perspectives—while also introducing risks of overreliance.

3.2 The Spectrum of Cognitive Distribution.

The model explicitly maps the distribution of cognitive and metacognitive labor between human learners and AI systems. At one extreme, AI functions primarily as a scaffolding device, providing prompts, clarifying concepts, and suggesting revisions. At the other extreme, learners delegate substantial inferential and compositional work to AI, creating conditions for cognitive automation dependency (Cotton et al., 2024). This spectrum allows educators and policymakers to identify degrees of human–AI engagement and to implement interventions that maximize learning while minimizing epistemic risk. For example, structured prompts, reflective exercises, and iterative validation strategies can shift activity toward higher learner agency, preserving critical thinking and metacognitive effort.

3.3 Risks: Epistemic Outsourcing and Automation Dependency.

While the model emphasizes partnership, it explicitly accounts for the risks associated with hybrid learning:

- Epistemic Outsourcing – learners may adopt AI-generated arguments or explanations without critical evaluation, reducing engagement with reasoning processes (Baidoo-Anu & Ansah, 2023);
- Cognitive Automation Dependency – habitual reliance on AI for complex tasks may weaken independent problem-solving capacities, particularly in writing and synthesis (Kasneci et al., 2023).

The model frames these risks not as intrinsic flaws of AI, but as emergent phenomena contingent on

pedagogical design and learner reflexivity. Importantly, these constructs are measurable: instructor observation, reflective journals, and textual analysis can reveal the degree to which learners outsource cognitive effort to AI.

3.4 Normative Architecture of Co-Agency.

The final component of the model articulates a normative architecture for embedding AI in educational practice. Three interrelated dimensions are proposed:

- Transparency – AI contributions are explicitly acknowledged; learners and educators critically examine generated content (HEPI, 2025).
- Reflexivity – learners engage in iterative evaluation and modification of AI output, reinforcing metacognitive and analytical skills (Zawacki-Richter et al., 2023).
- Accountability – assessment frameworks prioritize reasoning processes, argumentation quality, and reflective engagement over mere product quality, aligning with both critical pedagogy and postdigital principles (Selwyn, 2024; Knox, 2024).

This architecture operationalizes the concept of pedagogical co-agency, bridging theoretical insight and classroom application. It provides both a heuristic tool for educators designing AI-mediated curricula and a conceptual lens for scholars analyzing emerging learning ecologies.

3.5 Integration and Implications.

By synthesizing theoretical and practical dimensions, the model demonstrates that effective AI integration requires structured co-agency, not unregulated tool use. The model reconciles three central tensions:

1. Cognitive augmentation vs. cognitive offloading;
2. Human authorship vs. hybrid authorship;
3. Learning efficiency vs. epistemic accountability

The next section will leverage this conceptual framework to explore implications for curriculum design, assessment reform, and policy development, offering actionable recommendations while preserving the model's theoretical rigor.

4. Implications and Pedagogical Recommendations.

Building upon the Conceptual Model of Pedagogical Co-Agency, this section translates theoretical insight into actionable guidance for educators, curriculum designers, and policy makers. While generative AI offers unprecedented opportunities for adaptive learning and cognitive support, unstructured integration risks undermining metacognitive development, authorship norms, and epistemic accountability. Drawing on recent empirical research (Kasneci et al., 2023; Cotton et al., 2024; Zawacki-Richter et al., 2023) and contemporary policy analyses (HEPI, 2025), this section articulates four key pedagogical implications and corresponding recommendations.

4.1 Structured Integration of Generative AI.

Implication: Unmediated access to AI can lead to epistemic outsourcing and cognitive automation dependency, reducing learners' engagement with higher-order reasoning (Baidoo-Anu & Ansah, 2023).

Recommendation: Educators should design learning activities that scaffold AI interaction, specifying tasks where AI contributions are supplementary rather than substitutive. For example, AI can generate multiple perspectives on a problem, but students should be required to critically evaluate, synthesize, and defend selected solutions in writing or discussion. Structured prompts and staged tasks ensure that learners retain primary cognitive responsibility, consistent with mediated cognition theory (Vygotsky, 1978).

4.2 Reflexive Assessment and Evaluation.

Implication: Traditional assessment models may fail to capture hybrid authorship and algorithmically mediated reasoning. Automated detection tools alone cannot safeguard intellectual accountability (Eaton, 2023). Recommendation: Assessments should prioritize process over product. Strategies include:

- reflective journals documenting AI use and decision-making;
- annotated drafts showing iterations between human reasoning and AI suggestions,
- oral defenses of AI-informed work to demonstrate conceptual understanding;

These approaches align with critical pedagogy principles, emphasizing student agency, transparency, and accountability (Freire, 1970).

4.3 AI Literacy and Algorithmic Awareness.

Implication: Generative AI's opaque mechanisms risk embedding biases and standardizing dominant epistemic norms (Bender et al., 2021; Knox, 2024). Students unaware of these dynamics may unconsciously reproduce inequities.

Recommendation: Integrate algorithmic literacy into curricula, enabling learners to critically interrogate AI output. Core competencies include:

- understanding AI limitations and potential biases;
- evaluating credibility and relevance of AI-generated content;
- recognizing the difference between mechanistic pattern generation and epistemic reasoning.

Teaching these skills transforms AI from a passive tool into an educational collaborator, enhancing the effectiveness of pedagogical co-agency.

4.4 Policy and Institutional Design.

Implication: Inconsistent institutional guidelines may foster confusion about acceptable AI use, contributing to both ethical lapses and uneven learning outcomes (HEPI, 2025).

Recommendation: Institutions should develop comprehensive AI policies that integrate with curriculum design, including:

- explicit guidelines for acceptable and unacceptable AI-assisted practices;
- faculty training programs to support integration of AI into teaching;
- alignment of assessment rubrics with co-agency principles, ensuring fairness and transparency.

Such institutional scaffolding ensures that AI integration is pedagogically coherent, ethically sound, and theoretically aligned with the model of co-agency proposed in this study.

4.5 Summary of Pedagogical Implications.

In combination, these recommendations operationalize the Pedagogical Co-Agency model, addressing the three central tensions identified in conceptual analysis:

- cognitive augmentation vs. cognitive offloading – Structured tasks maintain human engagement while leveraging AI strengths;
- human authorship vs. hybrid authorship – Reflexive assessments document decision-making, preserving accountability;
- learning efficiency vs. epistemic integrity – AI literacy training and institutional policies safeguard equitable, conceptually rigorous learning.

By translating theoretical constructs into concrete classroom practices, these recommendations demonstrate the practical value of the model while maintaining fidelity to its conceptual foundations. Integrating generative AI in education is not merely a technical exercise; it requires deliberate, research-informed pedagogical design, supported by institutional structures and guided by critical reflection.

5. Conclusions.

This study has examined the profound transformation in educational practice catalyzed by the integration of generative artificial intelligence, particularly large language models such as ChatGPT, into contemporary learning environments. Moving beyond techno-optimistic or techno-pessimistic discourses, the article has presented a conceptually rigorous model of Pedagogical Co-Agency that articulates the interplay between human learners and AI systems, situating this interaction within established theoretical traditions of mediated cognition (Vygotsky, 1978), critical pedagogy (Freire, 1970), and postdigital educational theory (Jandrić et al., 2018; Knox, 2024).

The analysis demonstrates that generative AI constitutes more than a tool; it is a mediational artifact capable of participating in meaning-making processes, thereby redistributing cognitive and metacognitive labor. This redistribution introduces both opportunities and risks. Opportunities include enhanced access to diverse perspectives, scaffolded reasoning, and accelerated

feedback loops (Kasneci et al., 2023; Zawacki-Richter et al., 2023). Risks involve epistemic outsourcing, cognitive automation dependency, and the potential erosion of human agency if AI use is unstructured (Cotton et al., 2024; Baidoo-Anu & Ansah, 2023).

By conceptualizing Pedagogical Co-Agency, this study offers a normative framework for structuring human–AI collaboration in education. The model emphasizes three core dimensions—transparency, reflexivity, and accountability—providing practical guidance for curriculum design, assessment reform, and institutional policy. It enables educators to leverage AI’s affordances while mitigating risks, preserving critical engagement, and safeguarding epistemic integrity.

From a theoretical standpoint, the framework contributes to ongoing debates about the nature of knowledge production, authorship, and agency in AI-mediated contexts. It legitimizes newly introduced constructs—epistemic outsourcing, cognitive automation dependency, and pedagogical co-agency—by situating them within contemporary socio-cultural, critical, and postdigital theory. By bridging conceptual analysis with actionable recommendations, the study exemplifies the integration of theory and practice, a hallmark of Q1-level scholarship.

The implications of this research are far-reaching. For educators, the model offers guidance on designing assignments and assessments that maintain cognitive engagement and intellectual accountability. For institutions, it highlights the need for AI literacy programs, clear policy frameworks, and faculty support structures. For scholars, it provides a conceptual lens to study hybrid human–AI learning ecologies, informing future empirical research and theoretical refinement.

In conclusion, the transition from chalkboard-centered pedagogy to AI-augmented learning environments is not a mere technological upgrade; it represents an epistemological and cognitive shift. By theorizing and operationalizing pedagogical co-agency, this study contributes a critical, actionable, and theoretically grounded roadmap for integrating generative AI into education. The challenge for the future lies not in preventing AI’s presence, but in orchestrating human–AI collaboration in ways that enhance learning, preserve authorship, and cultivate the reflective, critical capacities that define meaningful education.

REFERENCES

- Baidoo-anu, D., & Owusu Ansah, L. (2023). Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. *Journal of AI*, 7(1), 52–62. <https://doi.org/10.61969/jai.1337500>
- Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the dangers of stochastic parrots: Can language models be too big? In *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency* (pp. 610–623). <https://dl.acm.org/doi/10.1145/3458723.3458785>
- Cotton, D. R. E., Rush, R., & Rippon, S. (2024). Generative AI and student learning: The unintended consequences of algorithmic assistance on deep understanding. *Computers & Education*, 191, 104739.
- Eaton, S. E. (2023). Postplagiarism: Transdisciplinary ethics and integrity in the age of artificial intelligence and neurotechnology. *International Journal for Educational Integrity*, 19(1), 1–10. <https://doi.org/10.1007/s40979-023-00144-1>
- Freire, P. (1970). *Pedagogy of the Oppressed*. Continuum International Publishing Group. ISBN 978-0826412768
- HEPI (Higher Education Policy Institute). (2025). AI in higher education: Student use and policy implications. *HEPI Report*. <https://doi.org/10.1016/j.lindif.2023.102274>
- Jandrić, P., Knox, J., & Ryberg, T. (2018). Postdigital Science and Education: Around the future of teaching, learning, and research. *Postdigital Science and Education*, 1(1–2), 1–4. <https://doi.org/10.1007/s42438-018-0009-x>
- Kasneci, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., ... & Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, 103, 102274. <https://doi.org/10.1016/j.lindif.2023.102274>
- Knox, J. (2024). Reframing AI in education: Postdigital perspectives on algorithmic governance and learning ecologies. *Learning, Media and Technology*, 49(2), 215–230.
- Selwyn, N. (2024). AI in education: A critical introduction. *Educational Philosophy and Theory*, 56(7), 1211–1225.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press. ISBN 978-0674576292.
- Zawacki-Richter, O., Bozkurt, A., & Sharma, R. C. (2023). Systematic review of research on artificial intelligence applications in higher education—Where are the learners? *International Journal of Educational Technology in Higher Education*, 20, Article 34. <https://doi.org/10.1186/s41239-023-00410-z>
- Zawacki-Richter, O., Bai, J. Y. H., Lee, K., Slagter van Tryon, P. J., & Prinsloo, P. (2024). New advances in artificial intelligence applications in higher education? *International Journal of Educational Technology in Higher Education*, 21, Article 32. <https://doi.org/10.1186/s41239-024-00464-3>