

Critical literacy and curriculum reform in the digital age: a pedagogical framework for artificial intelligence-integrated education

Pablo Agustin Artero Abellan¹, Maria Abellan²

¹Department of English Linguistics and Literature, Complutense University of Madrid, Madrid, Spain

²Dallas Independent School District, Dallas, United States

Article Info

Article history:

Received Sep 17, 2025

Revised Feb 12, 2026

Accepted Mar 29, 2026

Keywords:

Advanced learning theory

Artificial intelligence

Critical pedagogy

Curriculum innovation

Educational technology

ABSTRACT

Artificial intelligence (AI) is reshaping education and challenging traditional curriculum models, prompting new attention to critical literacy. However, most current approaches emphasize technical proficiency while neglecting ethical, epistemological, and civic dimensions. This article addresses this gap by proposing a conceptual framework for integrating AI into curriculum design through critical pedagogy and advanced learning theory. Using a theory-driven literature review, the study synthesizes global policy frameworks and educational innovations to develop a four-part model for AI-informed critical literacy. The guiding principles include: i) interrogation of AI outputs and logics; ii) development of multiliteracies and digital semiotics; iii) promotion of democratic dialogue and participatory ethics; and iv) design of adaptive, inquiry-based learning environments. Grounded in constructivist, connectivist, and Freirean theories, the framework positions AI as a context for critical inquiry and educational transformation. The article concludes with strategies for educators and policymakers to foster equity, agency, and ethical reflection in AI-integrated learning environments, and proposes directions for future empirical research.

This is an open access article under the [CC BY-SA](#) license.



Corresponding Author:

Pablo Agustin Artero Abellan

Department of English Linguistics and Literature, Complutense University of Madrid

Madrid, Spain

Email: pabloagustinartero@ucm.es

1. INTRODUCTION

The rapid expansion of artificial intelligence (AI) across all sectors of society is compelling educators and researchers to reconsider what we teach, how we teach, and why we teach. This article addresses these foundational questions by critically examining the curricular implications of AI and proposing a pedagogical framework grounded in critical literacy. The emergence of AI as a pervasive force in contemporary life has placed unprecedented demands on educational systems. From generative language models to algorithmic decision-making and adaptive learning platforms, AI is no longer a peripheral tool—it is a central actor reshaping knowledge production, communication, and institutional structures. Education systems across the globe are undergoing rapid technological transformation, and AI is now embedded not only in instruction but also in administrative decisions. While these developments offer tools for personalization and scalability, they also raise profound ethical, epistemological, and civic challenges that require deeper scrutiny [1].

While AI integration in education is often celebrated for its innovative potential, much of the current discourse remains dominated by functional perspectives—emphasizing tool mastery, digital competencies, and automation. These models overlook how AI transforms the nature of knowledge, power, and learning

itself. There is a lack of curriculum models that address these broader implications. What does it mean to be critically literate in an age when machines generate meaning and shape discourse? How can students be empowered not just to use AI, but to interrogate and reimagine it within their social and civic contexts?

This article proposes a theoretical framework for integrating AI into curriculum design through the lens of critical literacy and advanced learning theory. Rather than treating AI as a neutral tool, the framework positions it as a sociotechnical system with ideological, ethical, and political dimensions. Critical literacy—rooted in the work of Freire—calls for learners to read and write the world, not just the word. In the context of AI, this means cultivating the capacity to decode algorithmic systems and engage with them reflexively.

Drawing from constructivism, sociocultural theory, and connectivism, the framework responds to a curricular landscape that is still dominated by content delivery and standardization. To counter this, we propose four guiding principles: critical interrogation of AI outputs, development of multiliteracies, democratic dialogue and participatory ethics, and adaptive, inquiry-based learning. The goal of this study is to offer a curriculum model that moves beyond technical skill acquisition and fosters ethical agency, critical inquiry, and educational justice in AI-mediated environments. It contributes a conceptual foundation for future empirical research and practical implementation in diverse educational settings.

2. METHOD

This article adopts a conceptual and critical approach grounded in interdisciplinary literature synthesis. It does not present original empirical data but develops a theoretical framework by integrating insights from critical pedagogy, curriculum studies, and learning theory, with a particular focus on AI-mediated education. The goal is to generate actionable pedagogical knowledge by identifying key conceptual patterns across diverse contexts. The research design is based on a narrative, purposive literature review. The review process combined iterative thematic analysis of scholarly sources, global education policy documents, and curriculum innovations. To ensure conceptual depth, we focused on publications that directly address the intersection of AI, education, and critical or multimodal literacies.

Searches were conducted across ERIC, Scopus, Web of Science, and Google Scholar between January 2023 and August 2025, using combinations of the following keywords: “AI in education,” “critical literacy,” “datafication,” “curriculum reform,” “algorithmic bias,” “multiliteracies,” “critical pedagogy,” “digital semiotics,” and “AI ethics in schools.” Inclusion criteria were: i) peer-reviewed journal articles; scholarly books, or book chapters; ii) reports or policy papers from major international organizations (UNESCO, OECD, and International Society for Technology in Education or ISTE); iii) publications in English; iv) work published between 2005 and 2025, with emphasis on 2020–2025 literature; and v) explicit engagement with AI’s implications for curriculum, ethics, pedagogy, or literacy. Studies focused solely on technical AI applications or automation without pedagogical framing were excluded.

A total of 36 core sources were selected through iterative reading and theoretical sampling. These were supplemented by key policy documents and practitioner toolkits. The sampling strategy does not aim for statistical representativeness, but rather for conceptual saturation—capturing the diversity of current thought on AI-integrated curriculum reform. Illustrative case examples from the United States and Latin America were chosen based on pedagogical relevance and documented implementation of AI literacy initiatives. The resulting model is not intended as a universal template but as a heuristic framework to support ethically grounded and context-sensitive curriculum innovation.

2.1. Critical literacy and Freirean pedagogy in a digital age

Critical literacy, as both a pedagogical approach and epistemological stance, urges educators and learners to move beyond functional or neutral interpretations of text and knowledge. Rooted in Freire’s pedagogy of the oppressed [2], it positions education as a dialogic and transformative process, where reading and writing the word become instruments for reading and writing the world. Freirean pedagogy centers on *conscientização*—a critical consciousness that empowers individuals to interrogate social realities and challenge structures of oppression. This foundational principle assumes renewed importance in the context of AI, which introduces not only new literacies but also new forms of symbolic domination.

In contemporary digital ecologies, critical literacy must expand to encompass algorithmic outputs, data-driven communication, and the increasingly invisible mediators of meaning production. Janks [3] and Vasquez [4] have emphasized the multimodal and ideological dimensions of literacy in media-saturated environments. However, the arrival of generative AI systems—such as ChatGPT, DALL·E, or automated scoring tools—complicates the traditional literacies and semiotic resources that students are expected to master. These systems do not merely transmit meaning; they synthesize, prioritize, and sometimes fabricate information based on probabilistic models, trained on corpora that reproduce existing social biases [5], [6].

Freire's notion of problem-posing education invites us to situate AI not as a neutral technological tool, but as a curriculum object to be critically explored. The shift from dialogic to automated communication in education raises urgent questions about voice, agency, and critical participation [2]. A critical pedagogy of AI must cultivate awareness of how machine learning models encode particular ideologies, and how students can resist passive consumption of algorithmic outputs through discursive, reflexive, and ethical engagement.

As such, critical literacy becomes a pivotal framework for navigating the symbolic power of language [7], now entangled with the synthetic and automated grammars of AI. In sum, to remain faithful to Freirean principles in the age of AI, educators must foster critical engagements with language, code, and design—recognizing that texts now include not only books and articles, but data dashboards, recommender systems, chatbot interfaces, and machine-generated essays. This shift mandates new pedagogical strategies that balance empowerment with technical literacy, enabling students to both decode and recode their digital realities [2].

2.2. Advanced learning theory: constructivist, sociocultural paradigms, and connectivist thought

The pedagogical transformation envisioned in this article also requires grounding in contemporary theories of learning. Constructivism, particularly in Piaget [8] and Bruner [9] formulations emphasizes that learners construct knowledge actively, through cognitive disequilibrium, exploration, and reflection. These tenets remain especially relevant in AI-rich environments where students interact with dynamic, non-linear sources of information and experience frequent cognitive challenge from synthetic media.

However, it is Vygotskian sociocultural theory that offers a more robust framework for interpreting AI's mediating role in learning [10]. Vygotsky's concept of the zone of proximal development (ZPD) illuminates how learning is scaffolded through culturally embedded tools and social interaction. When AI functions as a cognitive assistant—such as an adaptive tutor or language model—it participates in shaping the ZPD, mediating not only tasks but also expectations, values, and epistemologies [10]. The critical question becomes: whose cultural tools are embedded in the AI, and what forms of knowledge are legitimated or excluded in the process?

Building on these traditions, connectivism has emerged as a response to the complexity and non-linearity of learning in networked digital spaces [11]. Connectivist theory conceptualizes knowledge as distributed across human and non-human nodes, emphasizing the importance of pattern recognition, digital navigation, and the ability to synthesize across sources. AI systems, especially those embedded in personalized learning environments and content curation platforms, reflect this distributed model. Yet connectivism must be revised through a critical lens: while AI facilitates access and efficiency, it also fragments attention, abstracts context, and risks reinforcing existing power asymmetries through opaque algorithms [12].

Recent scholars have proposed integrating these learning theories with critical digital pedagogy to better address AI's impact on cognition and curriculum [13], [14]. For example, learning is no longer only the acquisition of declarative knowledge, but also the development of metacognitive strategies for questioning digital authority, detecting manipulation, and participating ethically in networked publics. These expanded goals redefine not only how learning occurs but also what learning means in a post-digital society [13].

2.3. AI as epistemological and curricular disruptor

The AI represents a paradigmatic disruption to traditional epistemologies and educational frameworks. At the epistemological level, AI challenges human-centered notions of authorship, creativity, and judgment. Generative models blur the boundaries between original and derivative work, while predictive analytics redefine what it means to “know” by substituting probabilistic outputs for situated, contextualized understanding [14]. The deference to algorithmic authority in educational and societal settings fosters what Beer [15] calls metric power—the privileging of quantification over qualitative inquiry.

Critically, the design and deployment of AI systems are far from neutral. Noble [5] and Eubanks [16] have shown how AI infrastructures perpetuate systemic discrimination, especially when trained on biased or incomplete data. These systems operationalize dominant ideologies in subtle ways—through content filtering, predictive policing, surveillance, and automated evaluation—raising ethical concerns about equity, representation, and epistemic justice in educational contexts [17]. Curricula that fail to expose students to these realities risk reproducing, rather than transforming, socio-technological inequalities.

From a curricular standpoint, AI necessitates a shift from content-centric models to inquiry-based, process-oriented, and critically reflexive approaches [18]. It is no longer sufficient to include “digital skills” or “AI literacy” as discrete competencies; instead, AI must be addressed across disciplines as a site of ethical negotiation and meaning-making. As Williamson *et al.* [19] argue, AI in education is not merely an instructional tool—it is a sociotechnical actor that reshapes pedagogical relationships, institutional structures, and educational imaginaries.

The integration of AI into curriculum thus demands what Biesta [20] describes as subjectification: the formation of autonomous, critical individuals who can resist the dehumanizing tendencies of automation. This aligns with Selwyn [21] call for a “slow EdTech” movement that prioritizes pedagogical deliberation over techno-solutionism. When linked to Freire [2] praxis, this theoretical synthesis positions AI not as a neutral enabler of innovation, but as a political artifact to be decoded, discussed, and contested within a democratic educational space.

3. RESULTS AND DISCUSSION

The integration of AI into educational systems has exposed deep structural tensions within existing curricular frameworks. Traditionally organized around stable content domains, fixed learning outcomes, and standardized assessment regimes, many curricula remain ill-equipped to respond to the dynamic, distributed, and ethically complex nature of AI. As AI systems become increasingly embedded in classrooms, the disconnect between technological transformation and pedagogical preparedness becomes both an epistemic and civic concern [22].

3.1. Curricular challenges in the age of AI

This section proposes a series of pressing challenges that currently dominate debates around curriculum design and the inclusion of AI in education. While AI is often introduced through functional and tool-oriented approaches—emphasizing efficiency, personalization, and skills acquisition—such framings risk obscuring the broader power relations, value systems, and institutional logics embedded in educational technologies. Recent critical scholarship has therefore argued that curriculum responses to AI must move beyond instrumental uses of technology toward an examination of how AI reshapes authority, knowledge production, and educational governance [23]. From this perspective, the challenges are not merely technical or pedagogical, but deeply curricular and political in nature.

3.1.1. From functional to critical literacies

One of the most pressing challenges is the predominance of functional literacy models, which emphasize technical proficiency, basic digital skills, and instrumental use of technology [24]. While such competencies are necessary, they are insufficient in preparing students to critically engage with the architectures and implications of AI. A curriculum grounded in functionalism risks producing what Freire [2] described as the “banking model” of education, wherein learners passively receive information rather than actively interrogating and co-constructing knowledge.

Contemporary AI systems—especially those that generate, rank, and interpret texts—demand a broader conception of literacy that incorporates critical thinking, ethical reasoning, and sociotechnical awareness. Digital literacy must move beyond tool use toward a nuanced understanding of how meaning is produced and power is exercised in digital environments [11], [25]. In AI contexts, this involves deciphering how algorithms prioritize certain narratives, how datasets encode social values, and how automated systems shape user behavior. Without such critical lenses, students may become fluent in interacting with AI while remaining unaware of its ideological underpinnings and societal consequences [25].

3.1.2. Algorithm bias and the curriculum of control

Another curricular challenge lies in the tacit normalization of algorithmic surveillance and datafication as pedagogical practices. Many educational technologies—ranging from plagiarism detectors to learning analytics dashboards—rely on AI-driven surveillance mechanisms that reduce complex human behaviors to data points. Mendoza [26] have typified this as “surveillance capitalism,” wherein student data becomes both a commodity and a mode of behavioral control. Recent research on the datafication of teaching highlights how such systems reshape pedagogical authority and professional judgment, often shifting decision-making power away from educators toward algorithmic systems [20].

The curricular implications of this shift are profound. When learning is monitored, predicted, and corrected by opaque systems, the classroom becomes a site of algorithmic governance. The promise of personalization often masks a logic of control, where deviations from normative performance are flagged, corrected, or suppressed [27]. Curricula that fail to address these dynamics risk naturalizing them, training students to adapt to machine expectations rather than challenging the assumptions built into those machines [28]. Moreover, algorithmic bias—now widely documented in areas such as facial recognition [29], predictive policing [16] and automated hiring [30]—also permeates educational applications. If left unexamined, such biases can replicate systemic inequalities along lines of race, gender, class, and language within the curriculum. Educational systems must therefore embed critical discussions of bias, fairness, and transparency into their learning objectives, particularly in technology-focused or interdisciplinary subjects.

3.1.3. Decontextualized knowledge and loss of interpretive depth

AI technologies often operate by abstracting context in order to generalize across vast datasets. While this enables remarkable efficiency in pattern recognition and prediction, it can also undermine the contextual, cultural, and interpretive richness that is essential to meaningful learning. This decontextualization affects not only the outputs of AI systems but also the ways in which knowledge is conceptualized in curriculum documents [4].

For instance, when students use large language models to generate essays, summaries, or research ideas, the risk is that knowledge is reduced to pattern-based paraphrasing rather than deep conceptual engagement. Such practices can erode the interpretive skills that are central to humanistic disciplines, as well as the epistemic humility required to navigate ambiguity and contradiction [31]. Learning involves not only cognitive acquisition but also identity formation and ethical positioning—dimensions that are flattened in AI-mediated interactions if not accompanied by critical framing [32].

This flattening is compounded by curricula that prioritize measurable competencies over dialogic exploration. The pressure to standardize outcomes and demonstrate accountability often leads to rigid curricular structures that leave little room for uncertainty, failure, or intellectual risk-taking—all of which are essential for developing critical awareness in AI contexts. In this sense, AI does not merely challenge content; it challenges the very logic of curriculum design [21].

3.1.4. Teacher agency and technocratic reform

The rise of AI in education also reconfigures the role of educators, who are often expected to implement technology without sufficient time, training, or critical understanding. When curricular reforms are driven by technocratic logics—emphasizing innovation, scalability, and efficiency—teachers may find themselves marginalized or instrumentalized, rather than empowered as co-designers of meaningful learning experiences [16], [19]. This technocratic framing can result in what Biesta [20] terms the “learnification” of education: a shift in focus from the substance and purpose of teaching to the optimization of learning outcomes, often through data-driven systems. In the case of AI, this means that human judgment, ethical reflection, and pedagogical intuition may be subordinated to algorithmic guidance. Reclaiming the educator’s role as a critical mediator—someone who can challenge, contextualize, and co-create knowledge with students—is essential for resisting this trend.

These dynamics mirror broader labor trends in data-driven workplaces, where algorithmic management restructures autonomy and accountability, reinforcing the need for curriculum models that explicitly address power and control in AI-mediated environments [30]. Thus, AI poses not only technical or ethical challenges but also curricular ones. To meet them, educators and institutions must adopt a broader vision of literacy, learning, and curriculum—one that re-centers human agency, cultural interpretation, and ethical engagement at the heart of educational design [21].

3.2. Emerging innovations and policy responses

While the integration of AI into education has surfaced numerous theoretical and practical challenges, it has also catalyzed innovative responses across diverse educational contexts. Around the world, policymakers, educators, and curriculum designers are developing new frameworks to reimagine learning for the algorithmic age—frameworks that emphasize ethical engagement, critical inquiry, and interdisciplinary collaboration [30]. This section surveys a range of curricular innovations that demonstrate the potential for AI-aware, critically literate pedagogy, from top-down institutional models to grassroots educator-led practices [31].

3.2.1. Global frameworks for AI and digital literacy

At the policy level, several international bodies have proposed comprehensive frameworks that recognize the sociotechnical implications of AI. The recommendation on the ethics of AI explicitly calls for the incorporation of human rights, data sovereignty, and cultural diversity into AI education [18], [33]. It encourages national curricula to address not only how AI works, but also how it affects individual autonomy, collective behavior, and democratic participation when it comes, to governance-oriented principles [34].

Similarly, international discussions on AI and education increasingly advocate for a redefinition of key competencies in light of AI. Rather than narrowly emphasizing technical skills, these frameworks identify creativity, emotional intelligence, ethical reasoning, and systems thinking as essential for navigating hybrid human-machine environments [31]. Contemporary scholarship also warns against reductionist approaches to AI integration and instead promotes holistic, interdisciplinary, and socially responsible learning objectives [35]. These international guidelines represent an important shift toward integrating critical and civic dimensions into AI curriculum policy. Complementing these, the ISTE standards for students have been updated to reflect the need for computational thinking, digital citizenship, and empowered use of emerging technologies [31]. Although often rooted in the U.S. context, these standards are

increasingly adopted globally, and their evolution suggests a growing awareness that literacy in the age of AI must be both functional and critical.

While Li *et al.* [33] emphasizes human rights, cultural diversity, and data governance the framework developed by Arias *et al.* [36] prioritizes adaptability, creativity, and lifelong learning in AI-mediated economies. In contrast, the ISTE standards for students [37] operationalize AI literacy primarily through competency-based digital citizenship and computational thinking. Compared to these frameworks, the model proposed in this article places stronger emphasis on critical literacy, dialogic pedagogy, and epistemic agency, positioning learners not only as users of AI systems but as critical interpreters of their social, ethical, and political implications.

3.2.2. Case studies: curricular responses from practice

Concrete curricular initiatives provide further evidence of innovation at the classroom and institutional level. For example, Finland's elements of AI program—developed jointly by the University of Helsinki and Reactor—has been internationally lauded for making AI education accessible to broad publics [25]. Offered as a free online course with curricular adaptations for secondary and tertiary education, it includes modules on the ethical, social, and philosophical implications of AI. Importantly, the course has been integrated into both formal and informal learning systems, reflecting a commitment to lifelong, inclusive education.

Comparative research on AI in education across national contexts demonstrates that curriculum responses are shaped by cultural, political, and economic factors, underscoring the importance of context-sensitive AI literacy frameworks [14]. From a practitioner-oriented perspective, Camilleri *et al.* [38] similarly emphasizes that effective AI integration in classrooms depends on local educational cultures, teacher preparedness, and institutional constraints, rather than the wholesale adoption of standardized technological solutions. Together, these perspectives highlight the need for curriculum models that are both globally informed and locally adaptable.

In the United States, several school districts and teacher training programs have begun piloting “critical AI literacy” curricula. For instance, the Massachusetts Institute of Technology (MIT) media lab's teaching AI ethics initiative offers modular lesson plans that blend coding, narrative storytelling, and ethical debate [39]. Students engage with questions such as: Can an algorithm be racist? What does it mean to “train” a machine? These programs aim to cultivate reflexive, interdisciplinary competencies that merge civic education with computational thinking.

Latin America has also seen grassroots curricular responses rooted in social justice traditions [40]. In Argentina and Colombia, for example, teacher collectives have developed open-access toolkits for discussing AI in the context of economic inequality, surveillance, and indigenous knowledge systems [15], [26]. These efforts often draw from Freirean pedagogy [2] and critical digital literacy frameworks [41] and position AI not only as a subject of technical training but as a site of cultural negotiation and political resistance.

3.2.3. Teacher agency, dialogic pedagogy and student voice

A common thread across successful curricular innovations is the re-centering of teacher agency. Educators are not merely implementers of AI-enhanced tools or scripted curricula; they are co-designers of pedagogical experiences that respond to specific sociocultural contexts. When teachers are given professional autonomy, training, and institutional support, they can integrate AI literacy into diverse disciplines—whether through literature analysis, data ethics debates, or collaborative projects in design and technology.

In this vein, dialogic pedagogy plays a central role. Alexander [42] describes dialogic teaching as “the harnessing of the power of talk to stimulate and extend thinking and advance learning and understanding.” When applied to AI education, dialogic approaches allow students to question assumptions, share diverse interpretations, and co-construct meaning around complex issues such as automation, identity, and digital justice. Empirical studies in K-12 settings show that ethical discussions around AI support students' moral reasoning, civic engagement, and critical awareness when embedded into structured classroom dialogue [43]. This discussion promotes the metacognitive and ethical competencies necessary for critical literacy.

Student voice is equally crucial. Rather than framing AI as a top-down technological inevitability, forward-thinking curricula treat students as epistemic agents capable of shaping how AI is used, interpreted, and governed. Participatory projects—such as designing ethically responsible chatbots, mapping AI in everyday life, or conducting critical interviews with digital tools—position learners as active contributors to both knowledge and policy conversations. This aligns with democratic theories of education [42] and supports subjectification through praxis.

3.3. A pedagogical framework for AI-critical curriculum design

In response to the curricular and epistemological challenges, and building on global innovations and critical pedagogy traditions, this section proposes a framework for integrating AI literacy into the curriculum

through a critical, dialogic, and learner-centered approach. The framework is structured around four interrelated principles, each corresponding to a pedagogical orientation and set of learning outcomes. Together, they form a model for cultivating critical literacy in the age of AI—one that resists technocratic determinism while embracing technological engagement as a space for ethical inquiry, reflexive dialogue, and democratic participation.

3.3.1. Principle 1: critical interrogation of AI outputs and logics

A first principle of AI-informed critical curriculum design is to treat AI systems not merely as tools to be mastered, but as cultural texts to be read, questioned, and critiqued. Because AI systems are not neutral or purely technical artifacts, but rather products of human design embedded with values, biases, and political consequences [16], [42], a critical pedagogy must encourage learners to interrogate their logics and assumptions. This involves guiding students to analyze how and why AI systems operate, what perspectives they privilege, and what forms of knowledge they silence. For instance, one activity may involve comparing AI-generated news summaries or historical narratives with human-authored equivalents in order to detect omissions, distortions, or systematic patterns. By researching the origins of these discrepancies, students develop the capacity to recognize the ideological or epistemological assumptions encoded in algorithmic outputs. The expected learning outcomes include the ability to evaluate the trustworthiness and completeness of AI-generated content, as well as to articulate critiques of AI systems grounded in both ethical reasoning and empirical evidence.

3.3.2. Principle 2: multiliteracies and digital semiotics

A second principle involves expanding the concept of literacy to include multimodal and machine-mediated forms of communication across disciplines. As AI technologies increasingly mediate how meaning is produced and circulated—whether through voice assistants, image generation, predictive text, or automated grading—students require what Cope and Kalantzis [44] describe as semiotic agility, encompassing visual, algorithmic, and procedural literacies [45]. A critical curriculum must therefore prepare learners to interpret and produce meaning across multiple modes shaped by automation. One practical activity involves the creation of a “digital text portfolio,” in which students curate, annotate, and reflect on multimodal artifacts generated by or in collaboration with AI systems, such as chatbot conversations, AI-generated videos, or synthetic voices. By analyzing how format, affordance, and automation shape meaning, students develop the ability to critically interpret digital outputs, to apply relevant theoretical frameworks to multimodal analysis, and to recognize how interface design and machine mediation influence processes of meaning-making.

3.3.3. Principle 3: democratic dialogue and participatory ethics

A third principle emphasizes the importance of cultivating classroom environments in which students collaboratively examine the civic, social, and ethical consequences of AI. As AI increasingly shapes democratic life through algorithmic governance, surveillance, and platform moderation, curricula must empower learners to engage in deliberative dialogue about its role in society, particularly in relation to justice, inclusion, and data rights [26], [46]. To operationalize this aim, educators can design structured debates or deliberative forums that simulate real-world policy challenges, such as whether AI should be used in grading or who owns the data produced in classrooms. These exercises combine civic literacy with rhetorical skill and ethical analysis, enabling students to articulate reasoned positions on complex AI-related dilemmas [47]. In doing so, they learn not only to apply ethical frameworks to sociotechnical questions but also to collaborate respectfully in democratic dialogue, cultivating dispositions essential for critical citizenship in an AI-mediated world.

3.3.4. Principle 4: adaptive, inquiry-based, and reflexive learning design

The fourth principle emphasizes the design of learning experiences that are flexible, project-based, and oriented toward metacognitive growth rather than rote mastery. Given the rapid pace of AI development, curricula must be iterative, reflexive, and centered on inquiry, aligning with constructivist and connectivist principles that privilege self-directed exploration and the construction of new knowledge [11], [20]. A practical example is a semester-long inquiry project in which students investigate an AI-related theme of personal or societal significance—such as AI and climate modeling or AI in language translation—culminating in multimodal presentations that include reflective accounts of their evolving understanding. Through this process, learners acquire the ability to design and conduct original inquiry into the societal impacts of AI, demonstrate self-reflexivity in assessing their own learning processes, and synthesize insights from diverse technical, cultural, and ethical sources.

By operationalizing this and the previous principles, educators can construct curricula that respond to the complexities of AI while sustaining the emancipatory aims of critical pedagogy. The framework developed here fosters not only digital fluency but also epistemic vigilance, ethical agency, and the

imaginative capacity to envision and enact alternative futures within and beyond the classroom. To facilitate comparison and synthesis, Table 1 displays the four guiding principles of AI-informed critical literacy, outlining their orientations, illustrative activities, and expected learning outcomes. Table 1 synthesizes the four guiding principles of AI-informed critical literacy, illustrating how each principle connects a pedagogical orientation, example activity, and anticipated learning outcome. Moreover, Figure 1 synthesizes the four guiding principles of AI-informed critical literacy, mapping the conceptual progression from critical interrogation to reflexive inquiry and illustrating how each principle contributes to a curriculum design that is ethically grounded, dialogically rich, and responsive to the sociotechnical dynamics of AI. Figure 1 summarizes the four core principles guiding AI-critical curriculum development: i) critical interrogation of AI outputs and underlying logics; ii) development of multiliteracies and algorithmic semiotic awareness; iii) civic engagement through democratic dialogue and ethical deliberation; and iv) adaptive, inquiry-driven learning environments fostering metacognitive reflection.

Table 1. Summary of guiding principles for AI-critical curriculum design

Principle	Pedagogical orientation	Sample activity	Learning outcomes
Critical interrogation of AI outputs and logics	Treat AI as texts to be read, questioned, and critiqued	Compare AI-generated vs. human-authored texts	Identify bias, evaluate trustworthiness, articulate ethical critiques
Multiliteracies and digital semiotics	Expand literacy to include multimodal and machine-mediated forms	Create a digital text portfolio with AI artifacts	Develop multimodal literacy, interpret AI-mediated meaning
Democratic dialogue and participatory ethics	Foster deliberation on AI's civic, social, and ethical consequences	Structured debates on AI in education (e.g., grading, data ownership)	Articulate ethical positions, engage in civic dialogue, apply ethical frameworks
Adaptive, inquiry-based, and reflexive learning	Design flexible, project-based, metacognitive learning	Semester-long AI inquiry projects	Conduct inquiry, reflect on learning processes, synthesize across disciplines

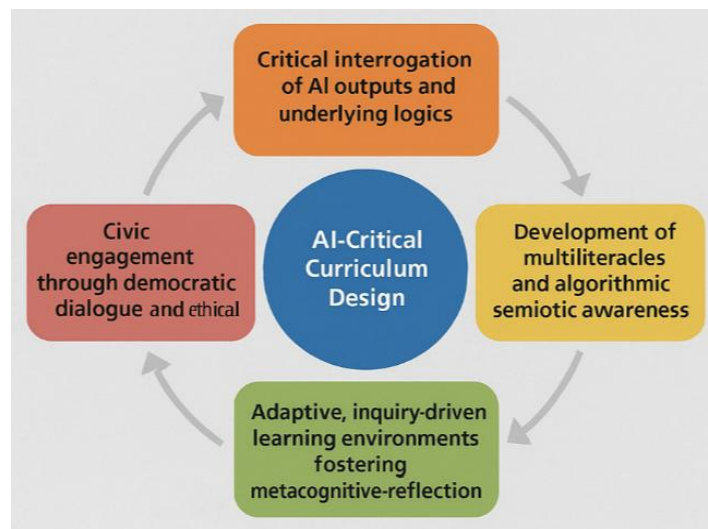


Figure 1. Pedagogical framework for AI-critical curriculum design

3.4. Practical implications for teachers

The developed pedagogical framework can be translated into practical classroom applications that promote critical engagement with AI technologies. Beyond technical proficiency, these applications are intended to support students' ethical awareness, agency, and holistic development within AI-mediated learning environments [48]. The strategies provide sample activities aligned with each of the four guiding principles and are adaptable across grade levels and subject areas.

3.4.1. Critical interrogation of AI outputs

- Activity: have students compare AI-generated news summaries or historical accounts with human-authored versions.
- Goal: guide students to identify bias, omissions, and epistemological differences; model questioning strategies such as “whose perspective is missing?” or “what assumptions are built into this output?”

Similar approaches are reflected in applied curricula such as the MIT media lab's teaching AI+ethics program, which integrates ethical reasoning, design thinking, and technical exploration in age-appropriate classroom activities [39].

3.4.2. Multiliteracies and digital semiotics

- Activity: assign students to analyze an AI-generated image, chatbot transcript, or video related to a curriculum topic.
- Goal: students evaluate how meaning shifts across modes (text, image, and audio), and reflect on the influence of algorithmic mediation.

3.4.3. Democratic dialogue and participatory ethics

- Activity: organize structured debates or role-play on real-world dilemmas (“should AI be used for grading?” and “who owns student data?”).
- Goal: cultivate civic reasoning, respectful dialogue, and ethical analysis using real policy or classroom scenarios.

3.4.4. Adaptive and reflexive inquiry

- Activity: support long-term projects where students investigate a personally relevant AI issue (AI in music, environmental prediction, and surveillance).
- Goal: through research, reflection journals, and presentation, students develop metacognitive awareness and interdisciplinary synthesis.

4. CONCLUSION

The rise of AI demands a profound rethinking of education's aims, practices, and values. This paper has proposed a conceptual framework that integrates critical literacy with AI pedagogy, offering an alternative to purely functional or technocratic models. Grounded in Freirean critical pedagogy and advanced learning theory, the framework centers on four guiding principles: critical interrogation of AI outputs, multiliteracies and semiotics, democratic dialogue, and reflexive, inquiry-based learning design. This theoretical contribution encourages educators to position AI not just as a tool but as a sociotechnical system embedded with power and ideology. Practically, it offers curricular strategies—such as debate, digital text analysis, and inquiry projects—that support critical engagement and ethical agency in AI-rich environments. The framework also provides guidance for policymakers in developing inclusive, justice-oriented AI education strategies.

Future research should empirically validate the framework across diverse educational contexts, exploring how it influences student outcomes, teacher agency, and curriculum design. Longitudinal studies, cross-cultural comparisons, and participatory research can illuminate how AI-critical literacy is enacted and adapted in practice. As educators confront the challenges of the digital age, curriculum must evolve not only to include AI but to critique, shape, and humanize it. The aim is not to automate education but to reclaim it as a space for ethical reflection, critical consciousness, and transformative learning. This framework contributes a theoretically grounded and pedagogically actionable model for integrating critical literacy and AI in contemporary curriculum reform.

ACKNOWLEDGMENTS

The authors would like to acknowledge the educators and researchers whose work in critical pedagogy and AI education inspired the conceptual framework presented in this study.

FUNDING INFORMATION

The authors state no funding involved.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Pablo Agustin Artero Abellan	✓	✓		✓	✓	✓			✓	✓	✓	✓	✓	
Maria Abellan		✓				✓	✓	✓		✓	✓	✓		

C : Conceptualization

M : Methodology

So : Software

Va : Validation

Fo : Formal analysis

I : Investigation

R : Resources

D : Data Curation

O : Writing - Original Draft

E : Writing - Review & Editing

Vi : Visualization

Su : Supervision

P : Project administration

Fu : Funding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Authors state no conflict of interest.

DATA AVAILABILITY

Data availability is not applicable to this study, as no new empirical data were created or analyzed. The article is based on a conceptual and critical synthesis of published literature, policy documents, and publicly available educational frameworks, all of which are cited in the reference list.




REFERENCES

- [1] W. Holmes, M. Bialik, and C. Fadel, *Artificial intelligence in education promises and implications for teaching and learning*, 1st ed. Boston, MA: Center for Curriculum Redesign, 2019.
- [2] P. Freire, "Pedagogy of the oppressed," in *Toward a Sociology of Education*, J. Beck, C. Jenks, N. Keddie, and M. F. D. Young, Eds., New York: Routledge, pp. 374–386, 2020.
- [3] H. Janks, "Critical literacy and the importance of reading with and against a text," *Journal of Adolescent and Adult Literacy*, vol. 62, no. 5, pp. 561–564, 2019, doi: 10.1002/jaal.941.
- [4] V. M. Vasquez, *Critical literacy across the K-6 curriculum*. New York: Routledge, 2016, doi: 10.4324/9781315642277.
- [5] S. U. Noble, *Algorithms of oppression: how search engines reinforce racism*. New York: New York University Press, 2020.
- [6] R. Binns, "Fairness in machine learning: lessons from political philosophy," in *Proceedings of the 1st Conference on Fairness, Accountability and Transparency*, pp. 149–159, 2018.
- [7] P. Bourdieu, *Language and symbolic power*. Cambridge, MA: Harvard University Press, 1991.
- [8] J. Piaget, *The origin of intelligence in the child*. London: Routledge, 2013, doi: 10.4324/9781315006260.
- [9] J. S. Bruner, *The process of education*. Cambridge, MA: Harvard University Press, 2009.
- [10] L. S. Vygotsky, *Mind in society: the development of higher psychological processes*. Cambridge, MA: Harvard University Press, 1978.
- [11] J. Kim and E. Maloney, *Learning innovation and the future of higher education*. Baltimore, MD: Johns Hopkins University Press, 2020.
- [12] B. Williamson, "Datafication of education: a critical approach to emerging analytics technologies and practices," *Rethinking Pedagogy for a Digital Age: Principles and Practices of Design*, 3rd ed., H. Beetham and R. Sharpe, Eds., New York: Routledge, pp. 212–226, 2019.
- [13] N. Selwyn, "The future of AI and education: Some cautionary notes," *European Journal of Education*, vol. 57, no. 4, pp. 620–631, Dec. 2022, doi: 10.1111/ejed.12532.
- [14] J. Knox, "Artificial intelligence and education in China," *Learning, Media and Technology*, vol. 45, no. 3, pp. 298–311, Jul. 2020, doi: 10.1080/17439884.2020.1754236.
- [15] D. Beer, *The data gaze: capitalism, power and perception*. London: SAGE Publications Ltd, 2018, doi: 10.4135/9781526463210.
- [16] V. Eubanks, *Automating inequality: how high-tech tools profile, police, and punish the poor*. New York: St. Martin's Publishing Group, 2018.
- [17] S. M. Liao, *Ethics of artificial intelligence*. New York: Oxford University Press, 2020, doi: 10.1093/oso/9780190905033.001.0001.
- [18] J.-S. Gordon and S. Nyholm, "Ethics of artificial intelligence." Internet Encyclopedia of Philosophy. Accessed: Jun. 17, 2025. [Online]. Available: <https://iep.utm.edu/ethics-of-artificial-intelligence/>
- [19] B. Williamson, S. Bayne, and S. Shay, "The datafication of teaching in higher education: critical issues and perspectives," *Teaching in Higher Education*, vol. 25, no. 4, pp. 351–365, May 2020, doi: 10.1080/13562517.2020.1748811.
- [20] G. Biesta, "What is education for? On good education, teacher judgement, and educational professionalism," *European Journal of Education*, vol. 50, no. 1, pp. 75–87, Mar. 2015, doi: 10.1111/ejed.12109.
- [21] N. Selwyn, *Should robots replace teachers?: AI and the future of education*. New Jersey: John Wiley & Sons, Inc., 2019.
- [22] N. Rice, J. M. Pêgo, C. F. Collares, J. Kisieleska, and T. Gale, "The development and implementation of a computer adaptive progress test across European countries," *Computers and Education: Artificial Intelligence*, vol. 3, p. 100083, 2022, doi: 10.1016/j.caeai.2022.100083.
- [23] L. Castañeda, A. Y. Postigo-Fuentes, and A. A. Sagasta, "Beyond tools, toward power structures: a critical review of AI in primary education," *Revista Española de Educación Comparada*, vol. 48, pp. 73–95, 2025, doi: 10.5944/reec.48.2025.45126.
- [24] M. G. Ames, *The charisma machine: the life, death, and legacy of one laptop per child*. Cambridge, MA: MIT Press, 2019.
- [25] D. Buckingham, "Defining digital literacy: what do young people need to know about digital media?" *Nordic Journal of Digital Literacy*, vol. 2015, no. 4, pp. 21–34, Oct. 2015, doi: 10.18261/issn1891-943x-2015-jubileumsnummer-03.
- [26] C. Mendoza, "The age of surveillance capitalism: the fight for a human future at the new frontier of power," *Church, Communication and Culture*, vol. 7, no. 2, pp. 452–455, Jul. 2022, doi: 10.1080/23753234.2022.2086891.




- [27] G. J. J. Biesta, *Good education in an age of measurement: ethics, politics, democracy*. New York: Routledge, 2015, doi: 10.4324/9781315634319.
- [28] S. M. H. Amiri, M. M. Islam, N. Akter, and S. M. H. Amiri, "Teaching tomorrow: global education in the age of technology," *Advanced Journal of STEM Education*, vol. 3, no. 2, pp. 1–22, 2025, doi: 10.31098/ajosed.v3i2.3535.
- [29] J. Buolamwini and T. Gebru, "Gender shades: intersectional accuracy disparities in commercial gender classification," in *Proceedings of the 1st Conference on Fairness, Accountability and Transparency*, 2018, pp. 77–91.
- [30] I. Ajunwa, *The quantified worker: law and technology in the modern workplace*. Cambridge, MA: Cambridge University Press, 2023.
- [31] G. Fan, "The reconfiguration of human education in an uncertain world," *ECNU Review of Education*, vol. 8, no. 3, pp. 609–637, Sep. 2025, doi: 10.1177/20965311241266856.
- [32] G. J. J. Biesta, *Beautiful risk of education*. New York: Routledge, 2015, doi: 10.4324/9781315635866.
- [33] Y. Li, L. Tolosa, F. Rivas-Echeverria, and R. Marquez, "Integrating AI in education: navigating UNESCO global guidelines, emerging trends, and its intersection with sustainable development goals," *ChemRxiv*, pp. 1–28, 2025, doi: 10.26434/chemrxiv-2025-wz4n9
- [34] D. Leslie and A. M. Perini, "Future shock: generative AI and the international AI policy and governance crisis," *Harvard Data Science Review*, no. Special Issue 5, 2024, doi: 10.1162/99608f92.88b4cc98.
- [35] J. Fjeld, N. Achten, H. Hilligoss, A. Nagy, and M. Srikumar, "Principled artificial intelligence: mapping consensus in ethical and rights-based approaches to principles for AI," *Berkman Klein Center Research Publication*, 2020, doi: 10.2139/ssrn.3518482.
- [36] J. Arias, J. I. Salas, A. Chiappe, and F. S. Delgado, "The extended education 4.0: lifelong learning in times of artificial intelligence," *Applied Sciences*, vol. 15, no. 17, p. 9352, Aug. 2025, doi: 10.3390/app15179352.
- [37] T. K. F. Chiu, "Student AI literacy and competency," in *Empowering K-12 Education with AI: Preparing for the Future of Education and Work*, T. K. F. Chiu, Ed., London: Taylor & Francis, 2025, pp. 31–54, doi: 10.4324/9781003498377-2.
- [38] V. Camilleri, A. Dingli, and M. Montebello, *AI in education: a practical guide for teachers and young people*. Malta: Department of Artificial Intelligence, Faculty of ICT, University of Malta, 2019.
- [39] R. Williams *et al.*, "AI+ethics curricula for middle school youth: lessons learned from three project-based curricula," *International Journal of Artificial Intelligence in Education*, vol. 33, no. 2, pp. 325–383, Jun. 2023, doi: 10.1007/s40593-022-00298-y.
- [40] N. M. Castillo, T. Adam, and B. Haßler, "Improving the impact of educational technologies on learning within low-income contexts," in *Learning, Marginalization, and Improving the Quality of Education in Low-Income Countries*, D. A. Wagner, N. M. Castillo, and S. G. Lewis, Eds. Cambridge, MA: Open Book Publishers, 2022, pp. 113–147.
- [41] O.-Y. Aparicio-Gómez and W.-O. Aparicio-Gómez, "Emerging technologies and their impact on Latin American teacher education: Lessons learned from Asian experiences," *Journal of Asia Pacific Studies*, vol. 7, no. 2, p. 97, 2024.
- [42] R. Alexander, *Towards dialogic teaching: rethinking classroom talk*, 4th ed. York, U.K.: Dialogos, 2008.
- [43] S. Akgun and C. Greenhow, "Artificial intelligence in education: addressing ethical challenges in K-12 settings," *AI and Ethics*, vol. 2, no. 3, pp. 431–440, Aug. 2022, doi: 10.1007/s43681-021-00096-7.
- [44] B. Cope and M. Kalantzis, *A pedagogy of multiliteracies: learning by design*. London: Palgrave Macmillan, 2016, doi: 10.1057/9781137539724.
- [45] C. Jewitt, J. Bezemer, and K. O'Halloran, *Introducing multimodality*. London: Routledge, 2025, doi: 10.4324/9781003513698.
- [46] N. Selwyn, S. Nemorin, S. Bulfin, and N. F. Johnson, *Everyday schooling in the digital age: high school, high tech?* Abingdon: Routledge, 2018.
- [47] R. Luckin, W. Holmes, M. Griffiths, and L. B. Forcier, *Intelligence unleashed: an argument for AI in education*. London: Pearson, 2016.
- [48] D. T. L. Shek, *Promoting holistic development in university students*. Singapore: Springer Nature Singapore, 2025.

BIOGRAPHIES OF AUTHORS



Pablo Agustín Artero Abellan    received his Ph.D. in Applied Linguistics from the Universidad Complutense de Madrid, where he is a doctoral researcher with the group 930160: Discourse, Communication, and Applied Linguistics. He also pursues doctoral studies in Baroque Aesthetics and Creative Writing at the University of Murcia and enrolled in an Education Doctorate (Ed.D) program at Liberty University. His current research interests include prosody, political discourse, critical pedagogy, and the intersections of language, technology, and education. He has published widely in peer-reviewed journals on linguistics, education, and political communication. He can be contacted at email: pabloagustinartero@ucm.es or paartero@liberty.edu.



Maria Abellan    is an Independent Educational Consultant and a K–12 teacher with the Dallas Independent School District, United States, specifically at Ebby Halliday Elementary School. She holds advanced degrees in education and has professional experience in curriculum development and bilingual education. Her research and practice focus on educational technology, critical literacy, inclusive pedagogy, and teacher training across international contexts. She combines classroom teaching with collaborative research in digital education and global learning. She can be contacted at email: marteroabellan@dallasisd.org.