From AI Intuition to AI Literacy: A Dual Framework for K-12 Education

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ABSTRACT

AI literacy has become a central framework for guiding the integration of artificial intelligence in K-12 education, emphasizing conceptual understanding, practical application, critical evaluation, and ethical judgment. These competencies are essential for supporting informed and responsible use of AI systems. However, classroom practice suggests that students often learn to engage with generative AI through exploratory and experiential interactions, experimenting with prompts, observing system behavior, adapting strategies, and reflecting on outcomes, before they can fully articulate formal concepts or rules. To account for this experiential dimension of learning, this paper introduces AI intuition as a complementary educational construct. AI intuition is defined as an experiential, inductive form of understanding that develops through iterative interaction with AI systems and supports context-sensitive judgment under uncertainty. We propose a dual framework in which AI literacy provides explicit knowledge, critical criteria, and ethical guidance, while AI intuition develops through iterative experience and reflection. These two dimensions interact dynamically and reinforce one another. We discuss pedagogical implications for K-12 education and outline directions for future research on experiential learning with AI.

Keywords: AI literacy, AI intuition, K-12 education, experiential learning, generative AI, educational framework, human-AI interaction, pedagogy, critical thinking, ethics of AI

Introduction

Artificial intelligence (AI) is rapidly transforming educational practices across K-12 and higher education, particularly within STEM disciplines. Indeed, at a time when algorithmic societies, AI, and their interface design influence human activities and development (Gardner-McTaggart & Blyth, 2025), their influence in the educational space has been growing and profound (Reimers *et al.*, 2026). In recent years, AI has fundamentally reshaped how students produce knowledge and perceive the world, making it a core part of the modern educational landscape. Over the past decade, research has documented a steady integration of AI-based tools for tutoring, assessment, personalization, and data-driven instruction (Lee & Perret, 2022; Xu & Ouyang, 2022). This evolution accelerated dramatically with the sudden public availability of generative AI (GenAI) systems such as ChatGPT, which introduced unprecedented capabilities in natural language interaction, problem-solving, content generation, and feedback at scale.

The speed and breadth of this adoption have surprised many educational institutions, forcing educators and policymakers worldwide to confront new pedagogical, ethical, and epistemic challenges (UNESCO, 2023a; National Council of Teachers of Mathematics, 2024). A growing body of empirical and review-based research now examines the educational impact of generative AI across diverse contexts, including mathematics, science, language arts, and interdisciplinary learning (Dao & Le, 2023; Klopfer *et al.*, 2024; Relmasira *et al.*, 2023). These studies consistently highlight the potential of GenAI to support learning through step-by-step guidance, adaptive explanations, and personalized feedback (Dao & Le, 2023; Rane, 2023; Sánchez-Ruiz *et al.*, 2023). When used thoughtfully, AI tools can enhance conceptual understanding, foster metacognitive reflection, and encourage students to interrogate the reliability and limitations of machine-generated outputs. At the same time, the literature raises substantial concerns about overreliance, hallucinations, bias, erosion of critical thinking, and blurring of authorship and agency in student work (Lo, 2023; UNESCO, 2023a).

As artificial intelligence becomes ubiquitous in K-12 environments, the educational focus has shifted from basic digital literacy to sophisticated AI competencies. International organizations and scholars now emphasize that students must develop a "human-centered mindset" and the ability to critically evaluate and co-create with AI systems (UNESCO, 2023b; 2023c). This shift reflects a broader systemic need for AI governance in education, moving beyond simple access to ensuring that all stakeholders possess the capacity to manage AI's ethical and practical complexities. Scholars have operationalized these requirements through the lens of "AI Thinking", a cognitive framework that empowers students to view AI not as a "black box," but as a transparent system defined by perception, representation, and reasoning (Touretzky & Gardner-McCune, 2022). In that context, the concept of AI literacy has emerged as a central organizing principle, encompassing (Long & Magerko, 2020; Touretzky *et al.*, 2019; Zhang *et al.*, 2023):

- An understanding of how AI systems work.
- The ability to use them effectively and responsibly.
- Critical evaluation of their outputs.
- Awareness of their ethical and societal implications.

Major institutional frameworks have articulated structured progressions, competencies, and learning outcomes intended to guide the integration of AI across K-12 education (OECD & European Commission, 2025; UNESCO, 2023b). Despite their breadth and rigor, existing AI literacy frameworks implicitly assume that learners can approach AI primarily through conceptual, declarative, and rule-based knowledge. In practice, both teachers and students often encounter AI systems, especially generative AI, in a far more exploratory, experimental, and uncertain manner. Learners frequently report developing a practical “feel” for how AI responds to different prompts, constraints, and contexts before they can articulate formal principles or technical explanations. This experiential dimension of learning with AI, while widely observed in classrooms, remains largely under-theorized in K-12 education research.

In parallel, the notion of intuition has a long intellectual history in philosophy, cognitive science, and education, where it is commonly understood as a form of knowledge that is experiential, inductive, and often tacit, and that precedes or complements formal reasoning (Dewey, 1933; Hogarth, 2010; Kahneman, 2011). In STEM education in particular, intuitive understanding has long been recognized as a necessary precursor to formalization, abstraction, and proof. However, intuition has rarely been discussed explicitly in the context of AI education.

An exception appears in recent work by Flechtner & Stankowski (2023) and by Flechtner & Kilian (2024), who introduce the term AI intuition in university-level design education to describe an experience-based understanding of AI developed through playful experimentation, embodied role-play, and hands-on prototyping. While this work provides important insights, the concept has not yet been extended to K-12 education. This paper addresses this gap by proposing AI intuition as a complementary pedagogical construct to AI literacy. We argue that effective AI education requires a dual framework that intentionally cultivates both:

- AI literacy, understood as structured, reflective, ethical, and conceptual knowledge about AI systems.
- AI intuition, understood as an experiential, inductive, and embodied understanding of how AI behaves in practice, developed through guided exploration, experimentation, and reflection.

To construct this dual framework, we conducted a selective, non-exhaustive review of literature spanning artificial intelligence in education, cognitive psychology, and the philosophy of intuition. Rather than a systematic review, sources were purposely sampled based on their relevance to generative AI integration in K-12 settings and the theoretical underpinnings of experiential learning. The selected literature was then qualitatively synthesized by the researchers to identify and extract key thematic intersections between existing AI literacy frameworks and the emergent concept of AI intuition (Beau & Lazar, 2025). Also drawing on direct, job-embedded observations from pedagogical practice in K-12 settings, researchers aim to offer pedagogical applications and instructional designs—rather than a formal "implementation" study. Our goal is not to replace AI literacy frameworks, but to strengthen them by accounting for how learners actually encounter and appropriate AI tools in practice.

Literature Review

The Impact of Generative AI and the imperative for AI Literacy

Recent research highlights the rapid integration of artificial intelligence (AI) into STEM education, with a steady stream of documentation of AI-based tools for tutoring and data-driven instruction over the past decade (Lee & Perret, 2022; Xu & Ouyang, 2022). However, the sudden emergence and widespread adoption of Generative AI (GenAI), such as ChatGPT, has taken many educational experts by surprise, prompting institutions globally to confront emerging ethical, pedagogical, and practical challenges (National Council of Teachers of Mathematics [NCTM], 2024; UNESCO, 2023a).

A significant body of recent work now seeks to assess the educational impact of GenAI across diverse contexts. Regional studies conducted in Vietnam, Massachusetts, and Southeast Asia have highlighted both the potential and limitations of these tools (Dao & Le, 2023; Klopfer *et al.*, 2024; Relmasira *et al.*, 2023). Specifically, the influence of GenAI on mathematics education and problem-solving skills has been extensively documented (Barana *et al.*, 2023; Dao & Le, 2023; Rane, 2023; Sánchez-Ruiz *et al.*, 2023). Research suggests that GenAI can support learning through step-by-step explanations, feedback, and assistance with problem solving, although the extent of these benefits may vary across educational contexts and learner populations (Dao & Le, 2023; Rane, 2023; Sánchez-Ruiz *et al.*, 2023). Additional comprehensive reviews and evaluations have further illuminated how GenAI is integrated into K-12 curricula and its impacts on educational practices (Chiu *et al.*, 2024).

However, challenges persist. The literature raises concerns about reliability, the need for tailored feedback mechanisms, and the potential for students to over-rely on AI, which could undermine the development of critical thinking (Lo, 2023; Rane, 2023; Sánchez-Ruiz *et al.*, 2023; UNESCO, 2023a). To mitigate these risks, the concept of AI literacy has emerged as a central organizing principle. AI literacy involves understanding fundamental AI principles, developing technical fluency, critically evaluating AI outputs, communicating effectively about AI, and grasping its ethical and societal implications (Long & Magerko, 2020; Touretzky *et al.*, 2019; Zhang *et al.*, 2023).

Major institutional frameworks have articulated competencies to guide this integration. The AI4K12 Initiative organizes concepts around "Five Big Ideas," emphasizing a "glass-box" approach that promotes transparency (AI4K12, n.d.; Touretzky & Gardner-McCune, 2022). Similarly, UNESCO's AI Competency Frameworks for students and teachers prioritize ethical, inclusive, and sustainable AI education (UNESCO, 2023b, 2023c). More recently, the AI Literacy Framework for Primary and Secondary Education (abbreviated as AILit Framework) has adopted a policy-aligned approach designed to inform the PISA 2029 Media & Artificial Intelligence Literacy assessment (OECD & European Commission, 2025).

The Theoretical and Educational Foundations of Intuition

While AI literacy frameworks focus on structured and conceptual knowledge, the role of *intuition*, often framed as immediate insight, has deep philosophical roots that are critical for understanding how learners interact with complex systems. Classical accounts frame intuition as a form of direct intellectual grasp. Plato described it as a "vision" of forms that transcends sensory experience, while Descartes characterized it as the mind's clear apprehension of self-evident ideas (Descartes, 1985; Plato, 1992). In contrast, Pascal distinguished between *l'esprit de géométrie* (analytical reasoning) and *l'esprit de finesse* (intuitive perception), a distinction that resonates with educational contexts where teachers often rely on nuanced, experience-based judgments (Pascal, 1963). Kant further defined intuition as the immediate reception of sensory data, arguing that concepts without intuition are "empty," and intuitions without concepts are "blind" (Kant, 1781/1998).

Phenomenology and psychology have expanded this understanding by emphasizing the active and embodied nature of intuition. Merleau-Ponty (1945/2016) argued that intuition is "motor and practical," inseparable from action and bodily perception. Gestalt psychologists, such as Köhler (1929) and Wertheimer (1923), demonstrated that perception is an active process of structuring data into a coherent whole rather than a simple sum of sensations. Contemporary neuroscience supports this, showing that the brain actively constructs perception using heuristics to anticipate and organize data (Gigerenzer, 2007; Noë, 2004).

In the educational sphere, Dewey (1933) argued that intuitive judgments often initiate reflective inquiry. Empirical studies confirm that experienced educators rely heavily on tacit, intuitive knowledge to navigate classroom complexity (Berliner, 2001; Eraut, 2000; Sipman *et al.*, 2019). Dual-process theories in psychology further illuminate this mechanism: Kahneman (2011) distinguishes between "System 1" (fast, intuitive) and "System 2" (slow, analytical). While intuition enables rapid, efficient learning, it can also lead to cognitive biases if not paired with analytical reflection (Hogarth, 2010; Kahneman, 2011). Thus, intuition is situated and culturally conditioned, requiring critical engagement (Foucault, 1966/1994; Heidegger, 1927/1986; Nisbett & Miyamoto, 2005).

From Expert Intuition to AI Intuition

The concept of "expert intuition" is particularly relevant to how students and teachers master new technologies. Research shows that experts in fields ranging from chess to medicine develop an intuitive ability to recognize patterns and make quick decisions without conscious deliberation (Crossan *et al.*, 1999; Kahneman & Klein, 2009; Walsh *et al.*, 2021). In clinical education, for example, novice clinicians are encouraged to harness intuitive pattern recognition alongside analytical reasoning to improve decision-making (Abdi *et al.*, 2016; Price *et al.*, 2016).

This relationship between intuition and expertise extends to Artificial Intelligence (Vincent, 2021). Deep learning systems, which learn from large datasets rather than explicit rules, develop pattern-recognition capabilities often compared to "artificial intuition" (LeCun *et al.*, 2015). In the context of AI education, Flechtner and Stankowski (2023) and Flechtner and Kilian (2024) have introduced the term AI intuition in university-level design education. They describe it as an experience-based understanding developed through playful experimentation and hands-on prototyping, allowing learners to assess whether AI is necessary for a project and to avoid over-reliance on it.

We propose extending this concept to K-12 education as a complementary goal to AI literacy. Just as expert intuition allows for rapid judgment in complex environments, AI intuition enables students to develop a practical "gut feeling" for how Generative AI behaves, anticipating hallucinations or context-dependent errors through inductive experimentation rather than purely theoretical study (Beau & Lazar, 2025). This dual approach integrates the "rational" (AI Literacy) with the "experiential" (AI Intuition), ensuring students become critical, reflective users of technology.

To bridge these concepts, it is necessary to transition from a metaphysical view of intuition to an action-based pedagogy in which learners co-constitute their reality through direct engagement with AI. This approach utilizes inductive experimentation and phenomenological mapping, such as stress-testing for hallucinations, to develop the "expert intuition" necessary for rapid, experience-based judgment. By integrating the "rational" (AI Literacy) with the "experiential" (AI Intuition), students transition from passive users to critical, reflective individuals who can anticipate AI behavior.

Conceptualizing AI Intuition in K-12 Education: A Dual Framework

AI literacy: structured understanding and critical awareness

Existing approaches to AI education in K–12 contexts are predominantly structured around the concept of AI literacy, as articulated in major research and policy frameworks (Touretzky *et al.*, 2019; Long & Magerko, 2020; UNESCO, 2023b, 2023c; OECD & European Commission, 2025). AI literacy is commonly defined as a set of knowledge, skills, and dispositions that enable learners to understand how AI systems work, use them appropriately, evaluate their outputs critically, and engage with them ethically and responsibly. We adopt this widely accepted definition as a baseline for our analysis. From this perspective, students develop AI literacy when they acquire and mobilize the following core competencies (see Figure 1):

- Conceptual understanding: understand foundational AI concepts such as data, models, learning processes, bias, uncertainty, and limitations, enabling learners to reason explicitly about how and why AI systems behave as they do;

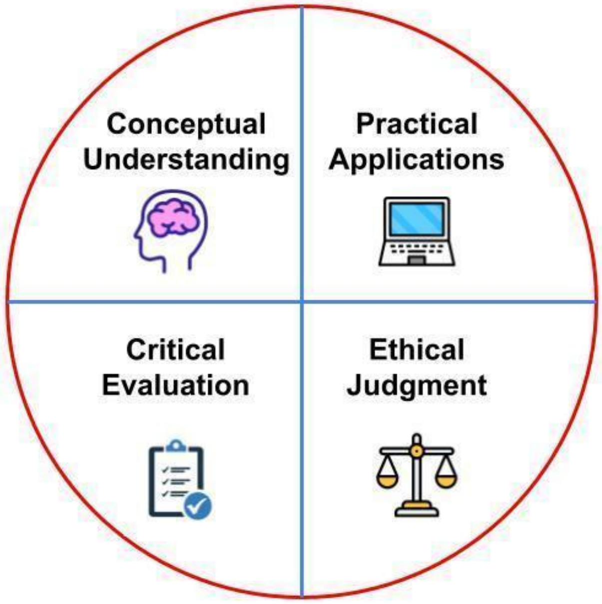
- Practical application: use AI tools effectively and appropriately in authentic academic and creative tasks, integrating AI as a support for inquiry, problem-solving, design, and communication rather than as a substitute for learning;

- Critical evaluation: critically assess AI-generated outputs for accuracy, reliability, bias, and relevance by applying verification strategies, cross-checking sources, and questioning apparent plausibility;

- Ethical and responsible judgment: make informed decisions regarding when, how, and whether to use AI, taking into account issues of academic integrity, privacy, authorship, fairness, and broader societal impact.

Figure 1

Core dimensions of AI literacy in K–12 education



AI literacy emphasizes explicit instruction, conceptual clarity, and reflective reasoning. It equips students with the language and analytical frameworks needed to interrogate AI systems, question their limitations, and situate their use within broader societal and ethical contexts. In classroom practice, AI literacy is typically cultivated through structured and guided activities such as source verification, bias analysis, discussions of academic integrity, and the critical evaluation of AI-generated content (UNESCO, 2023a; NCTM, 2024).

AI intuition: experiential and inductive understanding

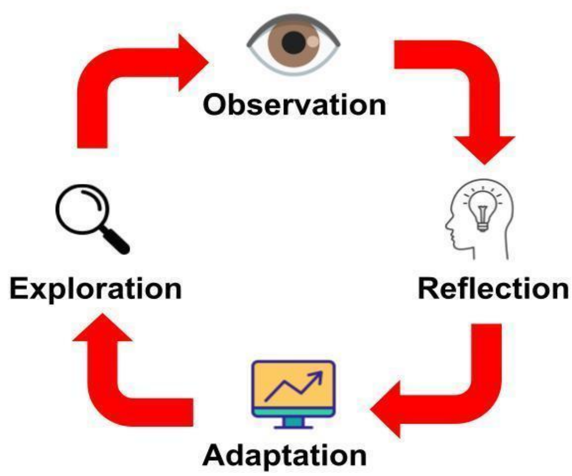
To make the experiential dimension of learning with AI explicit, we define AI intuition as an experiential, inductive understanding of AI systems developed through exploration, trial-and-error, and reflective engagement, enabling learners to anticipate AI behavior, adapt strategies, and make context-dependent decisions.

AI intuition is neither guesswork nor a substitute for knowledge. It should also not be confused with habitual use, familiarity with a particular tool, subjective confidence, or repeated prompt iteration. These may develop through frequent interaction without producing sound judgment about the reliability, limitations, or appropriate use of AI systems. Instead, AI intuition is a provisional, context-sensitive form of experiential understanding that develops through repeated interaction and reflection. Through use, comparison, and failure, learners formulate heuristics about how variations in prompts, constraints, and task contexts influence AI outputs. These heuristics become more reliable when they are tested through varied experience, feedback, verification, and analytical reflection, and may become misleading when they are based on narrow experience, habit, or unexamined confidence. However, these emerging intuitions remain fallible and may reinforce overconfidence or misleading expectations if they are not tested through verification and analytical reflection. Operationally, this analytical check can be supported through reflection tables in which learners compare their initial intention with the output produced, examine how their input shaped the result, and revise both their method and the provisional rules of thumb they have developed. For example, in an image-generation activity, students may assess whether the generated image corresponds to their intended meaning and modify the prompt accordingly. In a research activity assisted by AI, they can also evaluate whether a tool such as NotebookLM has identified and summarized the information required for the task. Such comparisons between intention, output, and verified results allow learners to confirm, qualify, or revise their emerging intuitions.

In classroom settings, AI intuition typically develops through an iterative learning cycle: exploration, observation, reflection, and adaptation (see Figure 2). This cycle captures how students move from initial experimentation to increasingly informed and self-regulated judgment about AI behavior.

Figure 2

Dynamical and Iterative learning cycle to develop AI intuition



Students develop AI intuition when they:

- Exploration: experiment with different prompts and input structures, including rephrasing questions, changing levels of specificity, and altering constraints, in order to probe how AI systems respond to variations in user intent and formulation;
- Observation: identify patterns, inconsistencies, and failure modes by observing when AI outputs remain stable, when they shift significantly, and when the system struggles, hallucinates, or invents information;
- Reflection: compare multiple outputs across exploratory and adversarial interactions (e.g., basic

prompts, rephrased prompts, contradictory or unusual inputs) to assess the reliability, scope, and limits of AI-generated responses;

- Adaptation: articulate evolving "rules of thumb" that guide future interactions, such as when to trust AI outputs, when verification is required, how to adapt prompting strategies, and when disengagement from the tool is epistemically warranted.

AI intuition, as defined here, is therefore not an incidental byproduct of AI use but a competence that must be intentionally cultivated in classroom practice. Developing this competence requires instructional designs that explicitly support the experiential learning cycle outlined above (see Figure 2), rather than focusing solely on final outputs or technical correctness.

To foster AI intuition, teachers must design activities and assessment practices that make each phase of this cycle visible and assessable. For example, in AI-assisted research activities (e.g., literature exploration and resource triangulation using AI-based research platforms such as NotebookLM), students are guided to explore AI tools through prompt variation, challenge systems with atypical or contradictory queries, and reflect explicitly on emerging patterns and limitations. Structured reflection tables and learning journals support the articulation of inductive heuristics, transforming tacit experience into shareable and evaluable understanding in the form of rules of thumb.

Beyond individual exploration, AI intuition is further strengthened through peer exchange and collective reflection. By comparing interpretations, strategies, and judgments in structured moments of dialogue, students refine their intuitions through exposure to alternative perspectives. Such exchanges may take the form of guided discussions or debates (e.g., "Should generative AI tools be used to write an English essay?") in which students must articulate, justify, and revise their positions based on both experiential evidence and ethical considerations. These dialogical moments help stabilize individual intuitions, surface implicit assumptions, and connect personal experience with shared norms of responsible AI use, thereby reinforcing the development of AI literacy.

This experiential learning complements formal instruction by allowing students to internalize AI behavior through scaffolded and age-appropriate engagement, rather than relying solely on abstract descriptions. Unlike prompt engineering, which focuses primarily on optimizing outputs through the refinement of inputs, AI intuition emphasizes experience-based epistemic judgment developed across repeated interactions with AI systems. It is reflected not simply in producing a successful prompt, but in recognizing recurring patterns and failure modes, anticipating when an output may be unstable or misleading, and adapting one's interaction by verifying, constraining, reformulating, or disengaging from the tool according to the context. A learner may therefore become skilled at eliciting a desired output without necessarily developing this broader, context-sensitive judgment. Additionally, executing this cycle in K-12 environments requires bounded classroom protocols. To respect age restrictions, ensure equitable access, and protect student data under school policy, these exploratory activities must take place within age-appropriate, institutionally approved AI environments (e.g., closed networks or 'walled-garden' platforms). Similarly, this cycle does not unnecessarily increase teacher workload, but rather map onto existing instructional strategies.

The exploration–observation–reflection–adaptation cycle can be adapted across K–12 education by progressively increasing learner autonomy, conceptual complexity, and responsibility. At the elementary level, teacher-guided activities may help students recognize that AI outputs can vary, contain errors, or differ from their initial intention. For example, students may describe or draw the image they expect an AI tool to generate, compare their prediction with the result, identify expected, unexpected, or missing elements, and complete a short oral or written reflection on what the activity taught them about the tool's behavior. At the middle-school level, students may engage in guided AI-assisted coding activities in which they compare the intended function of a simple program with its actual behavior, identify errors or unexpected results, revise the instructions or code, and reflect on the strategies that worked. At the secondary level, students may use tools such as NotebookLM to study a scientific article, answer source-based questions or quizzes, compare AI-generated information with the original text, assess the validity of the output and their own comprehension, and revise their strategies and expectations accordingly. These examples are illustrative rather than prescriptive and should be adapted to learners' developmental readiness, local curricula, and institutional policies.

Complementarity between AI literacy and AI intuition

AI literacy and AI intuition are not sequential stages but interdependent dimensions of learning. Their relationship is reciprocal and dynamic: AI literacy provides concepts, evaluative criteria, and ethical guidance that orient experiential exploration, while interaction with AI systems allows learners to apply, question, and refine this explicit knowledge in context. Together, they combine conceptual clarity and critical awareness with experience-based judgment in uncertain contexts. Their complementarity across key learning dimensions is summarized in Table 1. Analytical reflection connects these two dimensions by allowing learners to evaluate, correct, and recalibrate intuitions that may be incomplete or misleading. One way to operationalize this process is to ask students to use an AI tool to study a source and then complete questions or quizzes based directly on that source. For example, after using NotebookLM to examine a scientific article, students can be asked to assess the validity and relevance of the generated output, demonstrate their own understanding of the article, and reconsider whether their initial expectations about the tool were accurate. Discrepancies between the AI output, the source material, and the students' responses provide an opportunity to revise their strategies and emerging rules of thumb.

Table 1

Dual framework of AI literacy and AI intuition.

Category	AI Literacy Focus	AI Intuition Focus	Complementary Learning Outcome
1. Understand AI Concepts	Structured knowledge of how AI works (data, algorithms, bias, learning).	"Gut feeling" that AI behavior is context-sensitive and sometimes unpredictable.	Students know what AI is and also how it feels to use it in practice.
2. Use AI Tools Effectively & Creatively	Apply AI responsibly in tasks (research, writing, problem-solving, design).	Experiment with prompts, observe patterns, and refine strategies through trial and error.	Students become effective users who balance structured skill with creative exploration.
3. Evaluate AI Critically	Verify accuracy, assess bias, and consider fairness and	Recognize limits, errors, and surprises through	Students learn to trust but verify, combining fact-checking with

Category	AI Literacy Focus	AI Intuition Focus	Complementary Learning Outcome
	reliability.	observation.	practical awareness of AI’s flaws.
4. Apply AI Ethically & Responsibly	Understand privacy, academic integrity, and societal impact of AI.	Strategically decide when AI is valuable and when to avoid it.	Students develop responsible judgment, using AI only when appropriate and with awareness of consequences.
5. Reflect & Strategize	Critically examine how AI affects learning, society, and ethics.	Reflect on experiences to build “rules of thumb” for AI use.	Students learn both conceptual reflection (big-picture) and practical reflection (day-to-day use).

Note. This table summarizes the proposed dual framework by articulating how AI literacy (conceptual, ethical, and critical understanding of AI) and AI intuition (experiential, inductive judgment developed through interaction) address complementary aspects of learning with AI and jointly support students’ ability to use AI systems effectively and responsibly.

Discussion

The integration of generative AI into K-12 pedagogy necessitates a paradigm shift from purely rule-based computational thinking to a more nuanced, dual-process cognitive engagement. Our framework posits that AI literacy and AI intuition are not redundant but mutually reinforcing components of AI fluency. While literacy provides the essential elements to understand the deterministic logic and ethical constraints of AI systems, intuition provides the esprit de finesse (Pascal, 1963) needed to navigate the probabilistic, often unpredictable outputs of generative models. This distinction is critical; as AI systems grow in complexity, a purely rationalistic approach may fail to account for the context-dependent nature of machine learning, leaving students ill-equipped to manage the "black box" phenomena of hallucinations and emergent behaviors.

Furthermore, the dual framework offers a way to address concerns raised by educators and policymakers regarding youth development and the erosion of critical thinking. AI literacy provides explicit ethical and conceptual resources for understanding risks related to authorship, bias, and agency, while AI intuition may help learners apply these resources through practical and experiential engagement with AI systems. By developing an awareness of AI’s fallibility and reflecting critically on their interactions with these tools, students may strengthen their intellectual autonomy and become less likely to engage in passive or uncritical consumption. The framework therefore aims to support critical thinking and cognitive agency in an increasingly algorithmic society, although these proposed effects require empirical validation.

By engaging in inductive experimentation and phenomenological mapping, such as stress-testing prompts to identify where a model fails, students move beyond passive consumers to become "expert" observers of AI behavior. This hands-on, active experimentation enables students to develop a tactile understanding of AI. This pedagogical approach ensures that students co-constitute their learning environment through an active, embodied engagement with the technology.

The systemic implementation of this dual framework at the school level highlights the importance of fostering a "human-centered mindset" across the curriculum. As future assessments, such as the 2029 PISA Media and Artificial Intelligence Literacy standards (OECD & European Commission, 2025), are developed, educational institutions must ensure that AI education remains ethical, inclusive, and sustainable. Our model suggests that this is best achieved by grounding technical learning in experiential knowledge. By bridging the gap between formal theoretical instruction and the practical "gut feeling" of interaction, we empower a new generation of learners to navigate the ethical and practical complexities of an algorithmic society with both technical competence and reflective judgment.

Finally, there is a significant need for more practical AI-education literature that specifically addresses the experiential and intuitive dimensions of learning. Future research should focus on:

- Longitudinal Impact Studies: Investigating the long-term effects of cultivating AI intuition on students' critical thinking skills and their ability to navigate evolving algorithmic societies.
- Expansion of Practical Literature: Developing a more robust body of classroom-based research that moves beyond theoretical frameworks to provide evidence-based instructional strategies for fostering intuitive "gut feelings" alongside technical literacy, as well as assessment for the development of this capacity.
- Teacher Professional Development: Designing specialized training programs that equip educators with the pedagogical tools to facilitate inductive, exploratory learning environments.
- Domain-Specific Frameworks: Refining the Level 2 "Embodied-Technical Layer" by exploring how AI intuition manifests differently across diverse subjects such as the arts, humanities, and advanced sciences.

Conclusion

The transition from a purely rule-based approach to a dual framework of AI literacy and AI intuition marks a necessary evolution in K-12 education. As generative AI systems become more complex and deeply embedded in our daily lives, educators must equip students with the competencies required to fully harness their opportunities and address their challenges. This paper has argued that while AI literacy provides essential theoretical and ethical scaffolding, encompassing an understanding of how systems work and the ability to evaluate them critically, it must be complemented by AI intuition. This experiential, inductive "feel" for AI behavior allows learners to navigate the context-dependent and often unpredictable nature of modern machine learning.

Ultimately, the profound concerns surrounding youth development, cognitive agency, and the erosion of critical thinking highlighted at the outset of this paper cannot be addressed by rule-based knowledge alone. The dual framework directly answers these challenges: AI literacy provides the structured, critical awareness of AI's limitations, while AI intuition translates this awareness into daily, experiential resilience against overreliance. By marrying these two dimensions, the framework ensures that students do not surrender their cognitive autonomy to generative systems, but rather develop the robust intellectual agency required to thrive. By operationalizing this dual-level model, we provide a pathway for students to move from passive users to reflective individuals. This approach not only demystifies the "black box" of AI but also fosters the practical wisdom required to recognize hallucinations and bias through direct, playful experimentation. This synergy between the rational and the experiential ensures that students develop the "human-centered mindset" emphasized by global frameworks.

Looking forward, the alignment of this dual-level model with the upcoming PISA 2029 Media & Artificial Intelligence Literacy assessment highlights its strategic importance for international education policy. Future research should focus on the longitudinal impact of AI intuition on critical thinking and on the development of specialized teacher-training programs to support this inductive pedagogy. Ultimately, by bridging the gap between formal instruction and experiential discovery, we empower the next generation to navigate the complexities of an AI-driven society with technical competence, ethical responsibility, and intuitive confidence.

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Résumé / Resumen / Resumo

De l’intuition de l’IA à la littératie de l’IA : un cadre dual pour l’éducation primaire et secondaire

RÉSUMÉ

L’éducation à l’intelligence artificielle s’est imposée comme un cadre central pour guider l’intégration de l’IA dans l’éducation primaire et secondaire, en mettant l’accent sur la compréhension conceptuelle, l’application pratique, l’évaluation critique et le jugement éthique. Ces compétences sont essentielles pour soutenir un usage éclairé et responsable des systèmes d’IA. Cependant, les pratiques en classe suggèrent que les élèves apprennent souvent à interagir avec l’IA générative par des interactions exploratoires et expérientielles : ils testent des requêtes, observent le comportement des systèmes, ajustent leurs stratégies et réfléchissent aux résultats, avant de pouvoir formuler explicitement des concepts ou des règles formelles. Pour rendre compte de cette dimension expérientielle de l’apprentissage, cet article introduit la notion d’intuition de l’IA en tant que construction éducative complémentaire. L’intuition de l’IA est définie comme une forme de compréhension expérientielle et inductive, qui se développe par interaction itérative avec les systèmes d’IA et soutient un jugement contextuel en situation d’incertitude. Nous proposons un cadre dual dans lequel la littératie de l’IA fournit des connaissances explicites, des critères critiques et des repères éthiques, tandis que l’intuition de l’IA se développe par l’expérience itérative et la réflexion. Ces deux dimensions interagissent de manière dynamique et se renforcent mutuellement. Nous discutons des implications pédagogiques pour l’éducation primaire et secondaire et esquissons des pistes pour de futures recherches sur l’apprentissage expérientiel avec l’IA.

Mots-clés : éducation à l’intelligence artificielle, intuition de l’IA, éducation primaire et secondaire, apprentissage expérientiel, IA générative, cadre éducatif, interaction humain-IA, pédagogie, pensée critique, éthique de l’IA

De la Intuición en IA a la Alfabetización en IA: Un Marco Dual para la Educación Primaria y Secundaria

RESUMEN

A literacia em inteligência artificial tem-se afirmado como um quadro central para orientar a integração da IA na educação básica e secundária, enfatizando a compreensão conceptual, a aplicação prática, a avaliação crítica e o julgamento ético. Estas competências são essenciais para promover uma utilização informada e responsável dos sistemas de IA. No entanto, a prática em sala de aula sugere que os estudantes frequentemente aprendem a interagir com a IA generativa através de interações exploratórias e experienciais: experimentam instruções, observam o comportamento do sistema, ajustam estratégias e refletem sobre os resultados, antes de conseguirem formular plenamente conceitos ou regras formais. Para dar conta desta dimensão experiencial da aprendizagem, este artigo introduz a noção de intuição em IA como um constructo educativo complementar. A intuição em IA é definida como uma forma de compreensão experiencial e indutiva que se desenvolve através da interação iterativa com sistemas de IA e sustenta um julgamento contextual em situações de incerteza. Propomos um modelo dual no qual a alfabetização em IA fornece conhecimentos explícitos, critérios críticos e orientação ética, enquanto a intuição da IA se desenvolve por meio da experiência iterativa e da reflexão. Essas duas dimensões interagem de forma dinâmica e se reforçam mutuamente. Discutimos implicações pedagógicas para a educação básica e secundária e delineamos direções para investigação futura sobre aprendizagem experiencial com IA.

Palabras clave: literacia em inteligência artificial, intuição em IA, educação básica e secundária, aprendizagem experiencial, IA generativa, quadro educativo, interação humano-IA, pedagogia, pensamento crítico, ética da IA

Da Intuição em IA à Literacia em IA: Um Quadro Dual para a Ensino Básico e Secundário

RESUMO

A literacia em inteligência artificial tem-se afirmado como um quadro central para orientar a integração da IA na educação básica e secundária, enfatizando a compreensão conceptual, a aplicação prática, a avaliação crítica e o julgamento ético. Estas competências são essenciais para promover uma utilização informada e responsável dos sistemas de IA. No entanto, a prática em sala de aula sugere que os estudantes frequentemente aprendem a interagir com a IA generativa através de interações exploratórias e experienciais: experimentam instruções, observam o comportamento do sistema, ajustam estratégias e refletem sobre os resultados, antes de conseguirem formular plenamente conceitos ou regras formais. Para dar conta desta dimensão experiencial da aprendizagem, este artigo introduz a noção de intuição em IA como um constructo educativo complementar. A intuição em IA é definida como uma forma de compreensão experiencial e indutiva que se desenvolve através da interação iterativa com sistemas de IA e sustenta um julgamento contextual em situações de incerteza. Propomos um modelo dual no qual a alfabetização em IA fornece conhecimentos explícitos, critérios críticos e orientação ética, enquanto a intuição da IA se desenvolve por meio da experiência iterativa e da reflexão. Essas duas dimensões interagem de forma dinâmica e se reforçam mutuamente. Discutimos implicações pedagógicas para a educação básica e secundária e delineamos direções para investigação futura sobre aprendizagem experiencial com IA..

Palavras-chave: literacia em inteligência artificial, intuição em IA, educação básica e secundária, aprendizagem experiencial, IA generativa, quadro educativo, interação humano-IA, pedagogia, pensamento crítico, ética da IA