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EDITORIAL

The Urgent Case for AI Literacy in the 21st Century

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Abstract: Artificial Intelligence (AI) is reshaping how we learn, work, communicate, and interact with society. As intelligent systems become increasingly integrated into everyday life, fostering AI literacy has emerged as a critical educational and civic imperative. This editorial explores the evolving concept of AI literacy, emphasizing its cognitive, ethical, and pedagogical dimensions. Drawing on recent scholarly work, the article highlights the challenges and opportunities of integrating AI literacy into K–12 education, teacher preparation, and interdisciplinary curricula. It argues that AI literacy must be treated as a form of multiliteracy, spanning technical understanding, critical awareness, and metacognitive ability, and advocates for inclusive, reflective, and scalable educational frameworks. The article concludes with recommendations for policymakers, educators, and institutions to ensure AI literacy is accessible and equitable in the 21st-century learning landscape.

Keywords: Artificial intelligence, AI literacy, digital education, teacher education, curriculum development, multiliteracy, metacognition, ethics in AI, K–12 education, educational technology

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Introduction

Artificial Intelligence (AI) is not only transforming industries, it is also reshaping education, labor markets, communication, and democratic life. In this new era, the ability to critically understand, engage with, and responsibly use AI technologies is becoming essential. This ability is broadly captured by the concept of AI literacy, a term that encompasses technical knowledge, ethical awareness, and the cognitive competencies needed to interact with intelligent systems (Long & Magerko, 2020; Yi, 2021).

Despite its importance, AI literacy is still unevenly integrated into education systems, especially at the K–12 level (Casal-Otero et al., 2023). To ensure that future generations are empowered, not overwhelmed, by AI, we must embed AI literacy across all levels of education and teacher preparation.

What Is AI Literacy?

AI literacy involves far more than learning to code or understand machine learning algorithms. It includes the capacity to critically interpret how AI systems function, the data they rely on, their inherent limitations, and their socio-ethical implications (Chiu et al., 2024; Stolpe & Hallström, 2024). Long and Magerko (2020) identify core competencies such as understanding human-AI interaction, bias, explainability, and ethical decision-making. Yi

(2021) expands this view by introducing metacognition—the ability to assess what one needs to know and why—as a foundational component of AI literacy.

AI literacy is increasingly being differentiated from AI competency—the ability to apply AI knowledge confidently and meaningfully. Chiu et al. (2024) emphasize that education should cultivate both, proposing a five-component framework that includes ethics, collaboration, impact analysis, self-reflection, and technical knowledge.

The K–12 Imperative

The integration of AI literacy into primary and secondary education is an urgent yet underdeveloped priority. Casal-Otero et al. (2023) conducted a global review of K–12 AI education and found that existing approaches are fragmented. While some emphasize technical and conceptual learning experiences, others remain theoretical. Importantly, few studies assess whether students actually understand AI concepts after instruction.

Lee et al. (2021) provide a practical response through the DAILy (Developing AI Literacy) curriculum, a 30-hour program designed for middle school students. The initiative effectively improved conceptual understanding and fostered identity development among underrepresented students in computing. These results demonstrate the promise of inclusive, age-appropriate, and engaging AI education.

The Role of Teacher Education

One of the most underexplored areas in the discourse on AI literacy is teacher preparation. Sperling et al. (2024) note that AI literacy is often discussed without meaningful engagement with teachers' professional knowledge—particularly their ethical reasoning (*phronesis*) and pedagogical practice (*techne*). Their scoping review reveals that teacher education programs rarely equip educators with the understanding or tools needed to critically evaluate AI and guide their students.

Similarly, Laupichler et al. (2022) underscore the necessity of preparing educators to engage with AI both as a tool and as a topic of critical inquiry. They emphasize that teachers' own AI literacy must be supported if they are to foster it in students. This involves not only technical training but also reflection on ethical implications, data privacy, and inclusion

AI Literacy as Multiliteracy

AI literacy intersects with digital literacy, media literacy, and technological literacy. Stolpe and Hallström (2024) argue that it should be embedded within a broader conception of multiliteracy, integrating scientific, ethical, and practical domains. Their proposed framework highlights the importance of understanding systems, recognizing AI applications, and evaluating their social and ethical consequences.

This perspective is echoed in applied fields such as communication studies. Cardon et al. (2023) identify four critical dimensions, application, authenticity, accountability, and agency, as essential components of AI literacy in professional writing and workplace communication. These ideas suggest that AI literacy is not confined to STEM fields but is relevant across all academic and professional domains.

Measuring and Supporting AI Literacy

Despite the growing interest, there is limited empirical research on how to assess AI literacy. Hornberger et al. (2023) address this gap by developing a validated AI literacy test for university students. Their findings show substantial variance in students' understanding, with higher scores among those with technical backgrounds or prior AI exposure. This highlights the need for differentiated and inclusive instruction that builds on learners' existing knowledge and experience.

Conclusion

AI literacy is not merely a technical skill; it is a foundational element of digital citizenship. Its cultivation must begin in early education, continue through higher education, and be supported through lifelong learning. Teachers must be prepared not just to use AI tools, but to critique and teach them. Students must not only understand AI but also develop the agency to question its role in their lives.

Educational systems must respond to the AI era with intentional, reflective, and interdisciplinary frameworks. AI literacy is not just a competency for the future workforce, it is a right, a responsibility, and a requirement for navigating the complexities of the 21st century.

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