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Mapping the landscape of AI literacy; An integrative review

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ABSTRACT

This study presents an integrative review of scholarly literature published between 2016 and 2022 to synthesize how AI literacy has been conceptualized, taught, and measured. Drawing on over 40 empirical and theoretical sources, the review maps trends across educational levels—from primary to higher and adult education—and user groups, including students, teachers, professionals, and the general public. Key findings reveal significant diversity in pedagogical strategies, ranging from project-based learning and digital storytelling to flipped classrooms and professional development programs. Conceptualizations of AI literacy vary widely, encompassing technical, ethical, civic, and empowerment-oriented dimensions. Meanwhile, the field continues to face challenges related to definitional ambiguity, limited standardization of assessment tools, and inconsistent integration of ethical and socio-cultural considerations. The review emphasizes the need for convergence around shared frameworks, scalable pedagogies, and cross-contextual evaluation tools. It concludes by identifying future directions for inclusive, empirically grounded, and ethically aware AI literacy initiatives aimed at fostering reflective and informed engagement with AI systems.

INTRODUCTION

The integration of artificial intelligence into contemporary life has transformed not only economic production and digital communication but also education, governance, and everyday decision-making. From adaptive learning systems and algorithmic hiring tools to generative AI models used in creative writing and coding, AI technologies are increasingly influencing how individuals work, learn, and interact. As a result, the ability to engage meaningfully and critically with AI has become an essential competency across all sectors of society. This shift has given rise to the notion of *AI literacy*—a multidimensional construct that encompasses technical knowledge, ethical reasoning, data interpretation, critical reflection, and responsible usage of AI tools. Unlike traditional digital literacies, AI literacy requires a deeper understanding of algorithmic logic, automated decision-making, and

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the socio-cultural implications of machine intelligence.

Over the past five years, researchers and educators have responded to this imperative by developing conceptual frameworks, designing instructional interventions, and creating assessment tools to foster AI literacy. However, these efforts are varied in focus and scope. Some target early childhood and primary education through storytelling and unplugged activities, while others concentrate on adult learners, professionals, or educators through formal coursework and self-directed learning. The pedagogical approaches differ widely, encompassing project-based learning, flipped classrooms, inquiry-based instruction, and reflective teaching models. Despite this proliferation of activity, the field remains conceptually fragmented. There is limited consensus on how AI literacy should be defined, what its core components are, and how it should be measured across different populations and educational contexts. These inconsistencies hinder the development of scalable, inclusive, and empirically grounded AI literacy programs.

Moreover, while some frameworks emphasize technical proficiency and functional engagement with AI systems, others highlight the importance of ethical awareness, human-AI collaboration, and the societal consequences of algorithmic decision-making. Such consequences include the growing body of evidence that algorithmically mediated platforms, such as social media, can adversely affect users' mental health, fostering anxiety, low self-esteem, and body dissatisfaction—especially among younger demographics—through mechanisms of comparison, idealized self-presentation, and attention-driven design (Nosraty et al., 2021). This divergence reflects broader debates in the field over whether AI literacy should be approached as a set of cognitive and procedural skills, a civic responsibility, or a sociotechnical competence. Understanding AI literacy as a civic and sociotechnical capacity is especially vital in light of broader social dynamics—where inequality, repression, and injustice remain persistent structural threats. As with other forms of societal harm, fostering critical awareness and empowerment through literacy is key to resisting these systemic conditions (Maleki Borujeni, Jazayeri, & Salehi, 2022). Compounding these theoretical challenges is a lack of validated and widely applicable assessment instruments that can support empirical comparisons and instructional planning. Particularly underrepresented in the literature are cross-contextual analyses that examine how AI literacy manifests across diverse learner groups—such as children, university students, educators, and workers—and educational settings, including formal schooling, higher education, and vocational training.

This study addresses these gaps through an integrative review of peer-reviewed literature published between 2016 and 2022, encompassing empirical studies, theoretical models, and program evaluations related to AI literacy.

METHODOLOGY

To develop a comprehensive understanding of the evolving landscape of AI literacy, this study employed an integrative review methodology. The selection of this approach was guided by the need to synthesize a rapidly growing and interdisciplinary body of literature that spans multiple educational levels, user populations, and theoretical frameworks. A purposive sampling strategy was used to identify peer-reviewed studies published between 2016 and 2022, reflecting the intensified global focus on AI literacy in response to the proliferation of AI technologies in everyday life. Sources were selected based on their relevance to conceptualizations, pedagogical interventions, and assessment tools related to AI literacy. The review included both empirical and theoretical contributions to capture the breadth of discourse across diverse educational and professional contexts. Data extraction focused on study objectives, methodologies, target populations, conceptual frameworks, and findings, which were then analyzed thematically to identify common trends, gaps, and emerging directions in AI literacy education and research.

To ensure methodological rigor, the review adhered to established practices for scoping and systematic reviews, including transparent inclusion criteria, multi-database searches, and iterative coding procedures. Studies were categorized based on educational context (e.g., primary, secondary, tertiary, and adult education), population type (e.g., students, educators, general users), and the dimensions of AI literacy addressed (e.g., technical knowledge, ethical awareness, empowerment, practical application). Emphasis was placed on examining both the psychometric quality of AI

literacy assessment tools and the pedagogical strategies employed in literacy interventions, such as project-based learning, flipped classrooms, and digital storytelling. This analysis enabled the construction of a conceptual map of the field, revealing not only dominant frameworks and instructional practices but also underexplored areas requiring further empirical attention. The findings provide a foundation for proposing future directions in AI literacy development, particularly in terms of inclusivity, scalability, and ethical integration.

FINDINGS

Burgsteiner, Kandlhofer, and Steinbauer (2016) presented a pilot educational initiative designed to introduce high school students to foundational concepts in artificial intelligence (AI). Acknowledging the increasing significance of AI literacy for future scientific and engineering careers, the authors developed a comprehensive AI curriculum tailored for secondary education. The course encompassed a broad range of fundamental AI topics including problem solving, search algorithms, planning, graph theory, data structures, automata, agent-based systems, and machine learning. To enhance engagement and comprehension, the curriculum integrated both theoretical instruction and practical, hands-on components. The pilot implementation was empirically evaluated to assess its effectiveness in conveying AI principles. Evaluation results indicated that students successfully grasped the targeted AI concepts, demonstrating increased familiarity with and understanding of the covered topics. The authors concluded that the pilot course provided a strong foundation for subsequent efforts to incorporate AI education more broadly into secondary science curricula, and they highlighted the project's utility as a model for future implementations in diverse educational settings.

Kandlhofer et al. (2016) explored the integration of artificial intelligence (AI) and computer science into education across all levels, from kindergarten to university, to promote foundational AI literacy. Recognizing the growing ubiquity of AI in daily life and its projected relevance in future employment, the authors argued for the necessity of AI literacy as a core competency akin to traditional literacy. They introduced a structured educational concept designed to progressively develop AI understanding, using age-appropriate modules targeting four distinct educational stages. These modules covered key AI and computer science topics such as search algorithms, data structures, sorting, and graph theory. The authors implemented and evaluated four pilot modules corresponding to primary, middle, secondary, and tertiary education levels. Preliminary evaluations indicated that the framework was effective in engaging learners and enhancing their understanding of AI principles, suggesting that structured, early exposure to AI and computer science can be a viable strategy for fostering AI literacy. The study underscored the importance of long-term educational strategies to prepare students for AI-integrated futures.

Popenici and Kerr (2017) critically examined the growing influence of artificial intelligence (AI) on teaching and learning in higher education, highlighting both the transformative potential and the associated challenges of integrating emerging technologies into academic environments. The paper investigated how AI-driven innovations are reshaping instructional methods, student learning processes, institutional operations, and academic support services. It discussed the rapid pace of technological adoption within universities and emphasized the need for educational systems to adapt structurally and pedagogically to a future in which AI is deeply embedded. The authors outlined key challenges such as ethical concerns, the risk of dehumanizing education, and potential disruptions to traditional academic roles. They also identified areas requiring further empirical research, including the impact of AI on student engagement, critical thinking, and autonomy. The paper served as a foundational analysis, encouraging proactive engagement from educators and institutions to harness AI in ways that enhance rather than compromise educational quality.

Siau (2018) examined the transformative implications of artificial intelligence (AI) for higher education, arguing that academic institutions must proactively adapt to a rapidly evolving technological landscape. The article emphasized the urgency of preparing students for a labor market increasingly influenced by AI, robotics, automation, and machine learning. It explored the types of jobs most susceptible to automation and considered how educational institutions might restructure curricula to cultivate skills that are less vulnerable to displacement—such as critical thinking, creativity,

and emotional intelligence. The discussion included strategic recommendations for how higher education can remain relevant and thrive amid technological disruption. These included embracing digital transformation, integrating AI literacy across disciplines, and reimagining pedagogical methods to emphasize lifelong learning and adaptability. The article served as a conceptual reflection and call to action, highlighting the vital role of educational institutions in shaping future-ready graduates in the age of AI.

Zhang (2018) proposed an innovative educational model aimed at fostering AI literacy in early childhood through the integration of English language learning and robot education. The model involved the design of a specialized textbook that utilized robots to support English instruction, alongside the development of a corresponding curriculum tailored for use in kindergarten settings. This integrative approach was tested through an experimental implementation at a training institution, where its effectiveness in promoting both language acquisition and foundational technology-related competencies was evaluated. The findings indicated that the model was notably effective in enhancing young children's engagement and learning outcomes in both English and basic concepts related to robotics. The study suggested that early exposure to intelligent systems, when coupled with language development activities, could be a promising strategy for cultivating early-stage information and technology literacy among preschool learners.

Edwards and Cheok (2018) addressed the global teacher shortage by exploring the potential of artificial intelligence and robotics to assume independent instructional roles in educational contexts. The authors examined the feasibility of developing autonomous robot teachers capable of addressing both instructional and social demands typically managed by human educators. Drawing from current advancements in Artificial Intelligence in Education (AIED) and robotics, the paper outlined the conceptual requirements for robot teachers, including effective instructional delivery, social interaction, emotional responsiveness, and the embodiment of a teaching personality. The authors described their ongoing project involving the development of a robot teacher prototype designed to fulfill these roles, detailing its functionalities and intended use in classroom settings. While acknowledging skepticism surrounding the replacement of human teachers, the paper emphasized that robot educators could serve as viable alternatives in contexts of acute teacher shortages. The authors concluded by discussing potential future directions for research and development, including refining the social capabilities of educational robots and evaluating their long-term impact on learning outcomes.

Druga et al. (2019) investigated children's perceptions and understanding of AI technologies across different socio-economic and cultural contexts, with the aim of informing inclusive AI literacy education. The study involved 102 children aged 7 to 12 from four countries—the United States, Germany, Denmark, and Sweden—who were observed while imagining and discussing smart devices and AI-powered toys of the future. The research focused on how children conceptualized AI and collaborated in group activities, considering their exposure to technology and socio-economic background. Their findings revealed that children from outside the U.S. were generally more critical of AI technologies, likely due to lower exposure. Socio-economic status (SES) played a significant role in shaping both collaboration patterns and AI familiarity. Children from low- and medium-SES environments demonstrated stronger collaborative abilities but had limited experience with coding and digital tools, which affected their ability to articulate and build upon AI-related ideas. In contrast, children from high-SES backgrounds showed greater individual understanding of AI concepts but initially struggled with group collaboration. Based on these observations, the authors proposed a set of preliminary guidelines for designing hands-on AI literacy activities tailored for K–8 students. These recommendations emphasized the need for equitable access to AI learning tools, culturally responsive pedagogy, and opportunities for collaborative, exploratory learning with smart devices and toys. These insights align with growing recognition that media environments powered by algorithmic systems can subtly but powerfully shape user behavior—reinforcing norms, amplifying trends, and encouraging performative actions. In this light, cultivating critical media and AI literacy becomes essential for enabling individuals to recognize and

resist such behavioral conditioning (Soroori Sarabi et al., 2020).

Kong, Cheung, and Zhang (2021) evaluated the design and impact of a university-level AI literacy course tailored for students from diverse academic backgrounds. Recognizing the limited availability of accessible AI education for non-technical learners, the study aimed to determine whether students without prior programming experience could develop foundational AI knowledge and a sense of empowerment in engaging with AI technologies. The seven-hour course, offered to 120 volunteers from a pool of 4,000 students, focused on introducing core AI concepts such as machine learning, supervised and unsupervised learning, regression, classification, and clustering. Pre- and post-course surveys assessed changes in students' understanding of AI, their perceived AI literacy, and their sense of AI empowerment. Results indicated significant gains across all measures, with students demonstrating improved conceptual knowledge and increased confidence in engaging with AI-related topics. Importantly, the study found that prior programming experience was not a prerequisite for success in the course. The use of a flipped classroom model supported flexible, learner-centered engagement, contributing to positive learning outcomes. Moreover, the course helped to reduce disparities in AI literacy between students of different genders and academic disciplines. The findings support the scalability of AI literacy instruction across non-technical domains and suggest the potential for extending such courses to secondary education. The authors proposed future iterations that would incorporate AI application projects and ethical discussions to further enhance students' preparedness for participation in an AI-driven society. This call for deeper ethical engagement and institutional preparedness echoes broader findings that learners across diverse social backgrounds tend to welcome AI integration, yet consistently express concerns over faculty readiness and ethical safeguards—reinforcing the need for coordinated, equity-minded curricular reforms in AI education (Rahmatian & Sharajsharifi, 2021).

Kim and Lee (2022) developed a comprehensive assessment tool to measure AI literacy among middle school students, addressing a notable gap in educational evaluation resources for this age group. Recognizing the growing importance of AI education in K–12 settings, the authors aimed to provide a valid and reliable instrument that reflects the multifaceted nature of AI literacy and is tailored to the cognitive and developmental levels of adolescents. The development process involved the formation of an expert panel to identify relevant domains and construct corresponding items. The finalized instrument consists of 30 items across six key domains: *social impact of AI* (8 items), *understanding of AI* (6 items), *AI execution plans* (5 items), *problem solving with AI* (5 items), *data literacy* (4 items), and *AI ethics* (2 items). Each item is rated on a five-point Likert scale, allowing for nuanced responses to students' competencies and perceptions. To ensure the psychometric quality of the tool, the authors conducted a field review, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA). The scale demonstrated excellent internal consistency, with an overall Cronbach's alpha of .970 and subscale values ranging from .861 to .939, indicating high reliability across all domains. This validated instrument provides a foundational resource for educators, curriculum developers, and researchers aiming to assess and enhance AI literacy in middle school contexts. It offers practical applications for instructional design, formative assessment, and educational policy development within AI-focused curricula.

Wang, Rau, and Yuan (2022) developed and validated a quantitative instrument to measure AI literacy among general users, addressing the growing importance of evaluating user competence in interacting with AI technologies. The study proposed a multidimensional model of AI literacy composed of four core constructs: *awareness*, *use*, *evaluation*, and *ethics*. These constructs reflect a comprehensive understanding of the skills and knowledge required for responsible and effective engagement with AI in everyday life. An initial pool of 65 items was generated to capture these dimensions. After undergoing a three-step content validation process, the number of items was reduced to 31. Two rounds of data collection followed: the first sample was used for item reduction and exploratory analysis, and the second for reliability and validity testing. The final result was a 12-item scale that demonstrated strong psychometric properties and structural validity, confirming the appropriateness of the four-factor model. In addition to validating the scale, the study examined its external correlations. AI literacy was found to be positively associated with digital literacy,

users' attitudes toward robots, and the frequency of AI technology use in daily life. These findings support the relevance of the scale for both academic research and practical applications. The authors concluded that this tool can aid in assessing user readiness for AI interaction and inform the design of user-centered AI systems that align with varying literacy levels.

Ng, Luo, Chan, and Chu (2022) investigated the effectiveness of digital story writing (DSW) as an inquiry-based pedagogical approach for developing AI literacy among primary school students. Recognizing AI literacy as a critical competency in the 21st century, particularly in enabling individuals to use AI responsibly and creatively, the study explored how young learners could meaningfully engage with AI concepts through storytelling. The study involved 82 primary students in Hong Kong who participated in a three-month DSW program designed to teach foundational AI knowledge. At the end of the program, students completed a knowledge assessment to evaluate their conceptual understanding. The top 16 students were invited for artefact-based interviews, during which their digital stories were analyzed to examine how they represented and applied AI concepts. Findings indicated that students were able to formulate authentic, real-life scenarios and propose AI-driven solutions within their stories, demonstrating a capacity not only to understand AI concepts but also to creatively apply them. The DSW process was mapped onto an inquiry-based pedagogical cycle—including orientation, conceptualization, investigation, conclusion, and discussion—which provided a structured approach to exploring AI in a manner suitable for young learners. The study concluded that DSW holds promise as an effective method to scaffold AI learning in primary education. It supports students' development beyond basic conceptual knowledge by encouraging higher-order thinking, ethical reflection, and practical problem-solving through narrative construction. Such approaches are particularly valuable given evidence that adolescents' behavioral tendencies and decision-making styles—shaped in part by personality dispositions—can influence how they respond to social and technological cues. Embedding AI literacy in early education may thus help buffer against behavioral vulnerabilities linked to susceptibility and maladaptive engagement (Jamali, Salehi, & Chorami, 2022).

Schüller (2022) introduced a comprehensive framework for data and AI literacy aimed at establishing a unified understanding of these competencies across educational and societal domains. The proposed framework emphasizes the integration of data and AI literacy into school curricula, teacher training, higher education, and lifelong learning initiatives. It is designed to support the development of essential 21st-century skills through a transdisciplinary approach, incorporating three core perspectives: application-oriented, technical-methodological, and socio-cultural. By promoting a broad and inclusive understanding of data and AI literacy, the framework seeks to empower individuals to engage with data and AI technologies critically, ethically, and effectively. It highlights the necessity of equipping citizens with the capacity to interpret, apply, and question AI and data-driven systems in both personal and professional contexts. Importantly, the framework is intended not only for formal education but also for extracurricular and vocational settings, positioning it as a tool for public institutions to respond to the evolving demands of a data-intensive society. An illustrative example of the framework's application is the adult education app "Stadt | Land | Datenfluss," which operationalizes the framework's principles in an accessible format. This example demonstrates the framework's potential to support data and AI literacy beyond traditional classrooms, contributing to informed public discourse and responsible technological engagement. Schüller's work culminates in the *Data Literacy Charter*, advocating for coordinated efforts to institutionalize data and AI literacy across sectors. This underscores that data and AI literacy must also prepare individuals to interpret how narratives are constructed and disseminated—often through powerful framing techniques that shape public understanding. Without such critical capacities, media systems can distort perceptions and influence civic reasoning in subtle but far-reaching ways (Kharazmi & Mohammadi, 2020).

Wilton et al. (2022) addressed the critical and growing need for AI literacy among educators, particularly as AI technologies become increasingly embedded in formal education settings. The paper contributes to the discourse on *AI Literacy for Educators (AILE)* by examining how educators with varying technical backgrounds can develop the

competencies necessary to understand, evaluate, and responsibly integrate AI tools in their teaching practices. Drawing on three years of reflective data from a graduate-level course in Artificial Intelligence in Education (AIED), the authors explored how students—primarily educators—identified and critically analyzed AI applications. The course, designed by one of the authors, emphasized ethical and pedagogical considerations related to AI, including bias, privacy, inclusion, data collection, and explainability. Through both course activities and reflective inquiry, the study underscored the importance of equipping educators not only with technical understanding but also with critical awareness of the societal and ethical dimensions of AI use in education. The authors reviewed emerging scholarship on AIED to identify prevailing definitions and justifications for AI literacy. Their findings highlight the need for targeted frameworks that address educators' unique roles and responsibilities in navigating AI integration. The study advocates for a deliberate and reflective approach to developing AI literacy in educator preparation and professional development programs, emphasizing the dual necessity of technical competence and ethical insight. This need for ethical insight is amplified by evidence that algorithmically mediated norms—when left unexamined—can shape internal values, emotional well-being, and patterns of social conformity. Cultivating AI literacy is therefore essential not only for informed engagement, but also for fostering resilience against systemic and psychological manipulation (Nosraty et al., 2020).

Laupichler et al. (2022) conducted a scoping literature review to evaluate the current state of research on AI literacy within higher and adult education. Recognizing the growing pervasiveness of AI in daily life, the authors underscored the importance of equipping non-expert adults—such as university students and lifelong learners—with foundational AI knowledge to enable informed interaction with emerging technologies. The review aimed to identify thematic trends, recurring issues, and pedagogical structures used in AI literacy education at this level. The authors systematically searched ten academic databases and screened 902 records, ultimately including 30 studies based on defined eligibility criteria. The analysis revealed that AI literacy research in higher and adult education remains underdeveloped and conceptually fragmented. While several courses aimed at fostering AI literacy were identified, there was limited consensus on the definition of AI literacy for non-expert adult learners and insufficient detail on the specific content and competencies to be taught. Ethical considerations, technical understanding, and interdisciplinary perspectives appeared across the literature, but implementation approaches varied widely. The review called for more targeted research to develop refined pedagogical frameworks and validated assessment tools suited for adult learners. Additionally, the authors highlighted the need for more consistent integration of AI ethics, application-oriented learning, and inclusive curriculum design. Their recommendations emphasized establishing clearer competency models and improving the rigor and scope of future empirical studies in this emerging field. These recommendations are particularly salient when viewed alongside evidence that even well-resourced institutions can face major barriers to implementing inclusive, technology-supported learning in the absence of robust infrastructure and institutional coordination. Without such foundations, efforts to foster AI literacy risk becoming fragmented, exclusionary, or unsustainable (Mohammadi & Kharazmi, 2021).

Southworth et al. (2022) presented a transformative institutional model for integrating AI literacy across the undergraduate curriculum at the University of Florida (UF). Framed as a response to the increasing societal and workforce demands for AI competencies, the *AI Across the Curriculum* initiative aims to establish AI education as a foundational element of undergraduate education, regardless of discipline. The initiative is grounded in an AI literacy framework that emphasizes interdisciplinary learning, innovation, and student career readiness. At the core of this institutional strategy is UF's Quality Enhancement Plan (QEP), a requirement for reaccreditation, which has been strategically aligned with the AI literacy initiative. The proposed model offers a suite of curricular and co-curricular opportunities designed to expose all students—not only those in technical fields—to the ethical, societal, and functional dimensions of AI. These include new AI-infused courses, workshops, experiential learning opportunities, and discipline-specific applications of AI, fostering broad engagement and inclusion.

Allen and Kendeou (2022) proposed a comprehensive framework for AI literacy in

education, recognizing AI as a transformative force that necessitates a multidisciplinary approach. The ED-AI Lit framework, introduced in this study, is designed to inform research, practice, and policy by addressing the complex interactions between humans and AI technologies within educational contexts. The framework comprises six interconnected components: Knowledge, Evaluation, Collaboration, Contextualization, Autonomy, and Ethics. These components emphasize not only the need for individuals to understand the technical workings of AI systems but also to evaluate their broader societal and educational implications.

The authors highlight that effective AI literacy extends beyond technical proficiency. It requires critical thinking about the design, deployment, and consequences of AI in education, as well as the ability to navigate and collaborate with AI systems responsibly. Contextualization ensures that learners consider how AI operates in specific settings, while Autonomy and Ethics stress the importance of human agency and moral responsibility in AI-assisted environments. The ED-AI Lit framework thus offers a holistic vision for cultivating AI literacy, advocating for informed, reflective, and empowered engagement with AI technologies in educational systems.

Ng et al. (2022) provided a foundational overview of AI education and literacy within the broader context of K–16 classrooms, highlighting the pervasive influence of AI technologies across personal, professional, and educational domains. The chapter situates AI literacy as a necessary response to the growing ubiquity of AI applications—from smart home devices and search engines to educational tools powered by machine learning and natural language processing. As AI becomes increasingly embedded in everyday life, the authors argued for an educational paradigm that equips learners with the competencies needed to understand, use, and critically engage with AI. The chapter charted the evolution of the field of AI in education (AIED), emphasizing how AI technologies can personalize learning experiences, automate administrative tasks, and enhance interactivity in the classroom. These advancements, however, demand a shift in how educational systems approach digital literacy. AI literacy, as conceptualized by the authors, encompasses not only technical understanding but also awareness of ethical, societal, and cognitive implications. Through this lens, the authors advocated for the integration of AI literacy into the K–16 curriculum, underscoring its relevance across all educational levels. They called for coordinated efforts in curriculum design, teacher training, and policy development to support the effective and responsible use of AI in education. This chapter serves as both an introduction to the field and a rationale for making AI literacy a central component of 21st-century education.

Pretorius (forthcoming) offered a reflective account of teaching practices aimed at fostering AI literacy in higher education, particularly in the context of using generative AI tools with research students. The article begins by outlining the rising prominence and accompanying controversy of generative AI in educational settings, noting that debates often focus on concerns such as academic integrity and misuse. However, the author argues that such discourse overlooks the pedagogical potential of generative AI when used thoughtfully and transparently. The core of the paper presents a teaching strategy that integrates generative AI into research skills development. Pretorius described how modelling the use of generative AI tools—such as demonstrating how to interact with language models for brainstorming or refining writing—can scaffold students' understanding of AI's capabilities and limitations. This approach was intended not only to build technical familiarity but also to encourage critical thinking about how and when to use AI tools effectively and ethically. The reflection emphasizes that AI literacy should encompass more than tool proficiency. It involves developing a mindset of inquiry, responsibility, and strategic engagement with AI systems. Pretorius concluded that educators play a pivotal role in guiding students to view AI not as a shortcut, but as a collaborative aid in the learning process. Explicit modelling and critical dialogue around AI usage can thus serve as key components in cultivating AI literacy.

Çelebi, Yılmaz, Demir, and Karakuş (forthcoming) conducted a methodological study to adapt the Artificial Intelligence Literacy Scale (AILS), originally developed by Wang et al. (2022), into Turkish and assess its psychometric properties for use among non-expert adult populations. The study aimed to provide a valid and reliable tool for

measuring AI literacy in the Turkish context, supporting efforts to evaluate and promote AI understanding across diverse educational and societal settings. Data were collected from 402 participants, and the adaptation process involved a Confirmatory Factor Analysis (CFA) to assess construct validity, alongside reliability testing using Cronbach's alpha. The adapted Turkish version preserved the original structure of the AILS, consisting of 12 items across four factors. The CFA results indicated strong model fit indices (X^2/df = 1.82, RMSEA = 0.04, RMR = 0.03, NFI = 0.95, CFI = 0.98, GFI = 0.96, AGFI = 0.94), supporting the validity of the scale structure. In terms of internal consistency, the Cronbach's alpha coefficients for the four subscales ranged from 0.72 to 0.76, with an overall scale reliability of $\alpha = 0.85$, indicating high reliability. These results affirm that the Turkish version of AILS is a psychometrically sound instrument suitable for assessing AI literacy among adults in Turkish-speaking contexts. The authors concluded that the adapted scale can effectively support research and educational initiatives aimed at fostering AI literacy in Turkey.

Perchik et al. (forthcoming) evaluated the effectiveness of a multi-institutional AI literacy course designed for radiology residents across nine programs in the Southeast and Mid-Atlantic United States. The course aimed to address the growing need for AI education in radiology, given the increasing integration of AI tools in clinical practice and the notable lack of exposure among trainees. The week-long course was delivered remotely and consisted of ten 30-minute lectures that introduced fundamental AI terminology and methodologies, highlighted clinical applications across four radiologic subspecialties, and addressed broader topics such as AI ethics, algorithmic bias, economics, and medicolegal considerations. A hands-on component allowed participants to engage directly with an FDA-cleared AI-assisted viewer and reporting system for advanced cancer diagnostics. Pre- and post-course surveys were administered to evaluate changes in knowledge and participants' interest in further AI education. Results showed that most participants (96.7%) had not received adequate AI education during their training. The average AI knowledge score improved significantly from 8.3/15 to 10.1/15 after the course ($p = 0.04$), and a majority of respondents (78.6%) expressed interest in continued AI education.

CONCLUSION

This integrative review has examined the rapidly expanding and interdisciplinary field of AI literacy, drawing on a diverse range of empirical studies, theoretical models, and educational interventions published between 2016 and 2022. Across educational levels—from primary classrooms to professional and vocational training programs—AI literacy has emerged as a multifaceted construct, encompassing not only technical and conceptual knowledge but also ethical reasoning, critical engagement, and practical application. The reviewed literature reveals a growing consensus on the necessity of equipping individuals with the competencies to interact responsibly and reflectively with AI systems. However, it also highlights persistent fragmentation in how AI literacy is defined, operationalized, and assessed across contexts. While innovative pedagogical approaches and assessment instruments have proliferated, their conceptual underpinnings and target competencies vary significantly, reflecting tensions between functional, ethical, and civic orientations toward AI education.

The findings of this review emphasize the urgent need for convergence in the field—through clearer conceptual frameworks, validated cross-contextual assessment tools, and empirically supported pedagogical models that accommodate diverse learner needs. Future research must pay closer attention to inclusivity and equity, particularly in addressing disparities in access, prior knowledge, and socio-cultural contexts that shape learners' engagement with AI. Moreover, ethical dimensions must be more robustly integrated into AI literacy education, not as peripheral add-ons but as central elements that guide responsible technology use. Educators, curriculum designers, and policymakers are called to collaborate in institutionalizing AI literacy across formal and informal learning settings, ensuring that learners at all levels are not only informed users of AI but also critical agents in shaping its role in society.

CONFLICT OF INTEREST

No conflict of Interest declared by the author(s).

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