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AI Literacy in Review Studies: A Scoping Review

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ABSTRACT: *The rapid integration of Artificial Intelligence (AI) into daily life necessitates an understanding of AI literacy. This article presents a scoping review of review studies to examine how AI literacy has been conceptualized and developed across existing review literature. Guided by the Preferred Reporting Items for Systematic Reviews for Scoping Reviews (PRISMA) framework, this study screened fifteen review articles on AI literacy published between 2020 and 2025 in the SCOPUS database, of which eight met the eligibility criteria for inclusion. The review examines methodological approaches employed in previous reviews and the key findings related to AI literacy, including its conceptualizations, frameworks, and pedagogical development. The findings reveal that previous reviews employed diverse yet systematic methodologies, commonly guided by PRISMA frameworks and multiple academic databases. The review indicates the complexity in defining AI literacy with diversified frameworks. The review also shows that AI literacy is a dynamic and multidimensional construct with no universally agreed definition. Existing frameworks increasingly move beyond technical competencies to include ethical awareness, critical engagement, social responsibility, and human-AI interaction. In addition, the reviewed studies highlight experiential, participatory, and learner-centred approaches to developing AI literacy across educational contexts. Overall, the findings indicate a shift in AI literacy research from a primarily technical focus toward more critical, human-centred, and socially responsive perspectives. The study provides implications for future AI literacy research, curriculum design, and educational practice.*

KEYWORDS: **AI literacy, digital literacy, educational technology, scoping review**
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1. Introduction

AI is rapidly transforming everyday life, professional practices, and the global economy across sectors such as healthcare, finance, marketing, and education. As AI becomes increasingly embedded in human activities, the development of AI literacy—the ability to understand, use, evaluate, and critically reflect on AI technologies—has become an essential competency for both experts and non-experts. Consequently, scholarly interest in AI literacy has expanded significantly, resulting in a growing and diverse body of research.

However, existing reviews of AI literacy research often remain domain-specific. Previous systematic and scoping reviews have mainly focused on particular educational levels or professional contexts, including higher and adult education (Laupichler et al., 2022), K–12 learners (Zhou et al., 2025), teacher education (Sperling et al., 2024), healthcare (Kimiafar et al., 2023), and finance (Annu & Tripathi, 2025). While these reviews provide valuable insights into specific contexts, they offer only partial understandings of AI literacy as a broader interdisciplinary and socio-technical construct. In addition, differences in review methodologies, conceptualizations, and research focuses make it difficult to obtain a comprehensive understanding of how AI literacy has been examined across studies.

To address this gap, this study conducts a scoping review of review studies on AI literacy published between 2020 and 2025. By synthesizing existing review literature, the study aims to provide a broader understanding of methodological approaches and key findings in AI literacy research across educational and professional contexts. Specifically, the review

addresses the following research questions:

RQ1: What methodological approaches have been employed in previous reviews on AI literacy?
RQ2: What key findings on AI literacy have been reported in the reviewed studies?

To address the second research question, the review specifically examines the following aspects:

RQ2a: How has AI literacy been conceptualized?

RQ2b: What frameworks have been developed for AI literacy across educational contexts?

RQ2c: What pedagogical approaches and instructional designs have been identified for the development of AI literacy?

2. AI literacy: Concepts, frameworks, and contexts

The foundation AI literacy was developed by Long and Magerko (2020) as "a set of competencies that enables individuals to critically evaluate AI technologies; communicate and collaborate effectively with AI; and use AI as a tool online, at home, and in the workplace". Subsequent research has further expanded AI literacy from a narrowly technical construct into a multidimensional and human-centred framework (Ng et al., 2024). Rather than focusing solely on programming or algorithmic knowledge, recent perspectives conceptualize AI literacy as intersecting with related forms of literacy, including digital literacy (Bawden, 2008; Eshet, 2004), data literacy (Pangrazio & Selwyn, 2019), and computational thinking (Wing, 2006). This broader orientation reflects the recognition that individuals increasingly interact with AI not only as developers, but also as users, consumers, decision-makers, and citizens affected by algorithmic systems.

In parallel with these conceptual developments, several influential frameworks have been proposed to guide AI literacy education and policy. Long and Magerko's (2020) competency framework remains foundational, while international organizations such as the UNESCO and the OECD have emphasized ethical awareness, human-centred AI, and responsible participation in AI-driven societies (OECD, 2023; UNESCO, 2022). In educational contexts, age-appropriate and developmental frameworks have also been introduced, particularly for K–12 learners (Touretzky et al., 2019). These frameworks illustrate the increasingly interdisciplinary and socio-technical nature of AI literacy.

Existing research has examined AI literacy across a wide range of educational and professional settings. In K–12 education, studies have explored curriculum integration, pedagogical approaches, and the development of age-appropriate assessment tools, while also identifying persistent implementation challenges and contextual inequalities (Druga et al., 2017; Kandlhofer et al., 2016). In higher and adult education, research has primarily focused on undergraduate instruction, professional training programs, self-directed learning, and the educational use of AI tools across disciplines (Laupichler et al., 2022; Mah, 2016). Beyond formal education, AI literacy has also attracted growing attention in professional sectors where AI technologies increasingly shape decision-making and workplace practices. For example, research in healthcare highlights the need for practitioners to critically interpret AI-assisted diagnostics and data-driven systems (Choudhury & Elkefi, 2022; Topol, 2019), while studies in finance emphasize competencies related to algorithmic decision-making and digital financial systems (Lusardi & Mitchell, 2014; Philippon, 2019). Similarly, teacher education research has investigated how educators can develop the pedagogical and ethical competencies needed to integrate AI into teaching and learning processes (Holmes et al., 2019; Mishra & Koehler, 2006; Sperling et al., 2024).

Despite this growing body of literature, research on AI literacy remains fragmented across disciplines, educational levels, and professional domains. Most existing reviews focus on specific populations or contexts rather than providing a broader synthesis of how AI literacy has been conceptualized and operationalized across fields. The present study conducts a scoping review of review studies to provide a more comprehensive mapping of AI literacy research across domains and contexts.

3. Methodology

This study employed a scoping review of review studies to synthesize existing research on AI literacy. The study followed the PRISMA framework (Page et al., 2021), which includes the stages of identification, screening, eligibility assessment, and inclusion, to ensure methodological rigor and transparency throughout the review process. Figure 1 illustrates the selection process employed in this review.

3.1. Search strategy

A literature search was conducted using the SCOPUS database, which was selected because of its broad coverage of peer-reviewed international publications across education, technology, social sciences, and interdisciplinary fields. The search was conducted in July 2025 and focused on review articles published between 2020 and 2025. The search targeted article titles containing combinations of the keywords *"artificial intelligence," "AI literacy," "literacy,"* and *"review"* using Boolean operators. The following search string was used within the *Article Title* field in SCOPUS: ("artificial intelligence" OR "AI") AND ("literacy" OR "AI literacy") AND ("review"). The initial search identified 15 review articles. After screening and eligibility assessment, eight articles met the inclusion criteria and were retained for analysis.

3.2. Inclusion and exclusion criteria

An article was included if it: (1) was published between 2020 and 2025, (2) was written in English, (3) was a peer-reviewed study, and (4) focused explicitly on AI literacy. An article was excluded if it: (1) was a primary research study, editorial, or commentaries, (2) focused solely on technical AI development without discussion of AI literacy, or (3) was not available in English. The fifteen articles identified through the SCOPUS search were screened against these criteria, with eight deemed eligible for inclusion. One article was excluded during the eligibility stage because it was published in Chinese. Six were excluded because they are about other literacies than AI literacy, including critical literacy, childhood literacies, financial literacy, health information literacy, library information literacy, and a language and literacy perspective. Additional filtering criteria were also applied within the SCOPUS database. Specifically, the publication period was restricted to 2020–2025, and only articles categorized as *review* studies were selected. Table 1 summarizes the inclusion and exclusion criteria used in this review.

3.3. Data extraction and analysis

Data extraction focused on capturing the major characteristics and findings of the included studies. Information extracted from each article included: (1) authors and publication year, (2) title of the review article, (3) the study's purposes and objectives, (4) review methodology: databases used in these review papers, number of articles searched, inclusion criteria, exclusion criteria, number of articles reviewed, and (5) key findings. These data formed the basis for the synthesis presented in Tables 2 and 3.

A thematic analysis approach was employed to synthesize the findings. The analysis combined deductive and inductive coding procedures.

Table 1. Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Time frame	Published between 2020–2025	Published before 2020
Language	English	Non-English
Type of research	Review studies	Primary studies, editorials, commentaries
Type of publication	Peer-reviewed journal articles	Conference abstracts or non-peer-reviewed works
Content focus	AI literacy	Purely technical AI studies without literacy focus
Research findings	Studies reporting conceptual, pedagogical, ethical, or applied insights	Studies lacking relevant findings

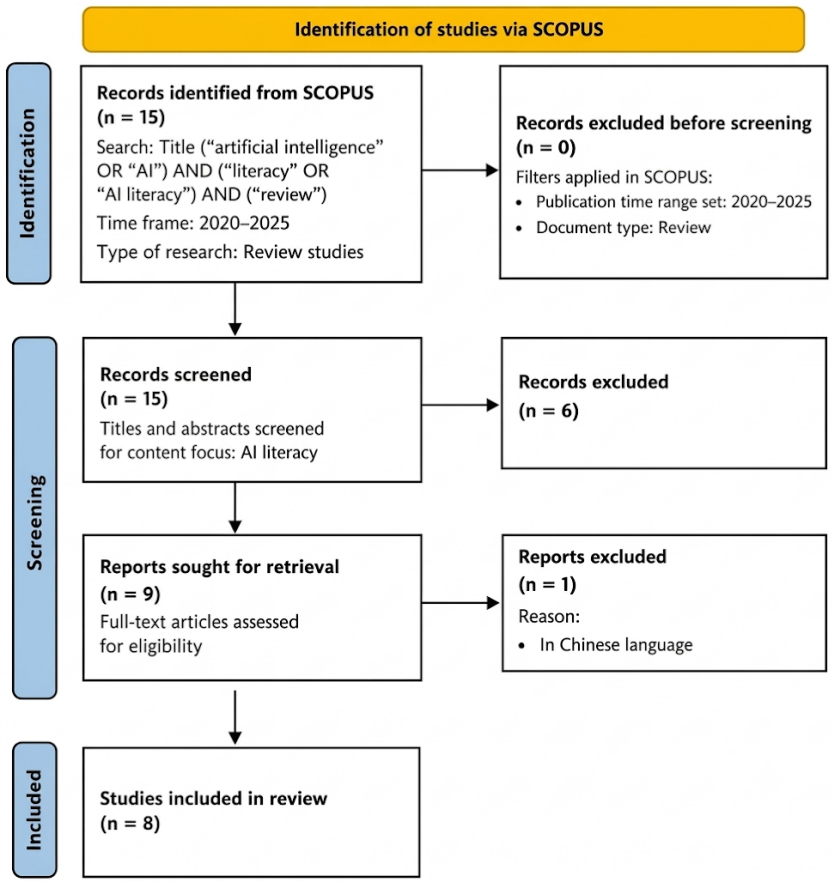


Figure 1. The PRISMA flowchart of the study selection process

Initially, two researchers independently reviewed and coded the included articles using deductive coding aligned with the study's research questions, particularly focusing on AI literacy conceptualizations, frameworks, and pedagogical development.

Following the initial coding stage, cross-review procedures were conducted to compare coding consistency and reduce potential researcher bias. Any discrepancies were resolved through discussion and consensus among the researchers. Subsequently, a second round of inductive analysis was conducted by examining recurring patterns across studies. Related codes were then grouped into broader thematic categories through team discussion. The final themes were synthesized to provide a structured synthesis of the current landscape of AI literacy research.

4. Results

4.1. Methodologies of the included studies

Table 2 summarizes the methodological characteristics of these studies, including the databases used, the number of articles identified, the inclusion and exclusion criteria applied, and the final number of articles reviewed.

The findings revealed diverse yet rigorous methodological approaches across the selected review studies. PRISMA-based procedures were commonly used to guide study identification, screening, eligibility assessment, and inclusion, reflecting an increasing emphasis on methodological transparency and reproducibility in AI literacy research. The reviewed studies relied on multiple academic databases, most frequently SCOPUS, Web of Science, ERIC, ACM Digital Library, and IEEE Xplore. Some reviews also incorporated PubMed, PsycINFO, ProQuest, and Google Scholar to broaden disciplinary coverage and capture interdisciplinary perspectives. The number of initially identified articles varied substantially across studies, ranging from 44 (Yim & Su, 2025) to 9,542 records (Kimiafar et al., 2023), largely depending on the breadth of search terms, databases, and disciplinary scope.

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Table 2. Database characteristics of the included studies

Authors (Year)	Database (s)	Articles Identified	Inclusion Criteria	Exclusion Criteria	Articles Reviewed
Laupichler et al. (2022)	PubMed, Web of Science, JSTOR, ERIC, IEEE Xplore, PsycINFO, ACM Digital Library, ScienceDirect, University and State Library Bonn	902	Peer-reviewed, higher/adult education, empirical, post-2000, English/German, explicit AI literacy focus	Non-higher/adult education, non-empirical, pre-2000, non-English/German, not AI literacy-focused	30
Kimiafar et al. (2023)	PubMed, Embase, SCOPUS, Web of Science	9,542	AI literacy in medical/healthcare professionals/ students, high-quality (JBI checklist)	Non-healthcare/medical students, unavailable full texts, non-English	10
Olari et al. (2023)	ACM Digital Library, Google Scholar	Not specified	Grounded in research, AI literacy in schools, empirically evaluated with students, English, accessible	Non-empirical, non-school focus, inaccessible	31
Sperling et al. (2024)	SCOPUS, Web of Science, ACM, IEEE Xplore, ERIC	650	Peer-reviewed articles/conference papers, English, AI literacy/education for K-12 teachers, pre-service teachers, teacher educators	Literature reviews	34
Yim (2024)	ACM, IEEE, SCOPUS, Web of Science	1,550	Peer-reviewed journal articles/conference papers, English, relevant to AI literacy, conceptual, frameworks, design considerations, all educational levels	Irrelevant, duplicates, not discussing AI literacy frameworks for teaching	19
Veldhuis et al. (2025)	ACM Digital Library, IEEExplore, SCOPUS, ERIC, PsycINFO, International Society of Learning Sciences repository, Google Scholar	1,179	Empirical, children's critical literacy of AI, ages 5-18, English, peer-reviewed, last 10 years	Non-empirical, non-critical engagement, outside age range, non-English	30
Yim & Su (2025)	SCOPUS, Web of Science	44	AI literacy education in primary schools, empirical, with data, published by March 2024	Non-empirical, non-primary school focus	25
Zhou et al. (2025)	ProQuest, SCOPUS, Web of Science	986	Empirical, K-12 AI literacy/competency, peer-reviewed journal articles/conference papers, English	Reviews, conceptual papers, unreliable data analysis	47

Across the studies, inclusion criteria generally prioritized peer-reviewed English-language publications explicitly related to AI literacy. Several reviews focused on particular contexts, including K–12 education (Zhou et al., 2025), higher education (Laupichler et al., 2022), healthcare (Kimiafar et al., 2023), or teacher education (Sperling et al., 2024). Final article counts varied significantly, from 10 (Kimiafar et al., 2023) to 47 (Zhou et al., 2025).

This methodological diversity underscores the interdisciplinary nature of AI literacy research, most focusing on education and one on healthcare.

4.2. Key findings from the reviewed studies on ai literacy

This section presents the key findings identified in the reviewed articles. Table 3 summarizes the purposes and major findings of the included review studies.

4.2.1. Conceptualisations of AI literacy

Across the included review studies, AI literacy emerges as a contested, evolving, and multidimensional construct rather than a stable or universally agreed educational outcome. Although most scholars broadly define AI literacy as the knowledge and skills needed to understand, evaluate, and use AI technologies ethically and effectively, substantial conceptual variation remains regarding its boundaries, components, and intended educational purposes (Laupichler et al., 2022; Sperling et al., 2024; Yim & Su, 2025; Zhou et al., 2025).

One study debated the distinction between AI literacy and AI competency. Earlier conceptualizations often treated AI literacy as an umbrella construct encompassing understanding, use, and broader dispositions toward AI. However, more recent research argues for clearer differentiation. Zhou et al. (2025), building on Chiu et al. (2024), conceptualize AI literacy primarily as an individual's knowledge and skills to explain how AI functions, recognize its societal implications, and engage with AI ethically and responsibly. In contrast, AI competency extends beyond cognitive mastery to include confidence, self-reflection, adaptive learning, and the effective application of AI in real-world contexts. Under this perspective, literacy serves as a foundational condition for competency, while competency reflects the quality and sustainability of AI-enabled performance.

At the same time, these studies also reveal continuing disagreement over whether "AI literacy" is itself the most appropriate conceptual label. Laupichler et al. (2022) identify competing constructs such as *AI readiness* and *AI capabilities*. Yim and Su (2025) define AI literacy in primary education as a multidimensional educational capability that enables children to understand, interact with, and critically engage with AI in everyday contexts. Their synthesis identifies four foundational dimensions underpinning this definition: digital literacy (interacting and collaborating with AI), computational thinking (algorithmic reasoning and problem-solving), AI ethics (responsible and socially aware AI use), and critical data literacy (understanding data, bias, and algorithmic consequences). These results reflect broader tensions about whether AI-related human development should emphasize technical understanding, affective preparedness, or transferable human capacities. Although Long and Magerko's definition remains the most influential reference point, related literature has yet to achieve conceptual consensus.

Importantly, recent reviews challenge techno-solutionist assumptions embedded in much AI literacy research. Sperling et al. (2024) argue that AI literacy is frequently portrayed as a universally measurable and transferable capability detached from professional and contextual realities. Ethical concerns are often reduced to technical matters, while critical evaluation is encouraged but insufficiently theorized or operationalized. This is also aligned with another review confirming the lack of the socio-cultural perspective in defining AI literacy (Olari et al., 2023). Consequently, AI literacy is increasingly understood not as merely acquiring technical knowledge, but as developing context-sensitive capacities that integrate technical, ethical, societal, communicative, and reflective dimensions and are enacted through situated practice rather than decontextualized instruction.

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Table 3. Key findings of the reviewed studies

Authors	Title	Purposes	Findings
Laupichler et al. (2022)	Artificial intelligence literacy in higher and adult education: A scoping literature review	To evaluate the current state of literature on AI literacy in higher and adult education, identify thematic foci and recent research trends. Answered questions on thematic foci, AI literacy definition, academic disciplines/target groups, and teaching formats/content.	Research in this area is still in its infancy. Thematic Foci: Most discussed conceptual properties, AI literacy definitions (8 studies on core skills/ competencies, often conflicting) and relevance in higher/adult education. Students recognize AI literacy importance for professional life. Definition: 83% of studies provided definitions; largely agreed it's less about programming and more about general understanding. Long and Magerko's (2020) definition was widely adopted.
Kimiafar et al. (2023)	Artificial intelligence literacy among healthcare professionals and students: A systematic review	To investigate the level of AI literacy among healthcare professionals and students.	Low level of AI literacy (preparation, knowledge) was reported in 40% of studies among healthcare professionals/students. Radiologists had acceptable literacy. One study showed significant improvement after training. Majority of healthcare professionals and students were motivated to use AI to improve healthcare and welcomed it in clinical contexts. Few participants received adequate AI training.
Olari et al. (2023)	Introducing Artificial Intelligence literacy in schools: A review of competence areas, pedagogical approaches, contexts and formats	To examine which practices and formats for introducing AI literacy in schools have been empirically evaluated, used repeatedly, or are challenging/need further exploration.	Socio-cultural perspective is underrepresented in current practical studies, which is concerning for developing responsible/critical AI users. Technological and user-oriented perspectives were dominant. Most works used data to introduce machine learning concepts (focus on analysis/evaluation stages, less on cleansing/ optimization/visualization). Activities were often artificially created tasks, with students rarely transferring knowledge to new domains or self-chosen projects. Most activities were outside regular computer science curriculum, embedded in other subjects or extracurricular. Teachers were rarely involved in the education process or prepared as multipliers.
Sperling et al. (2024)	In search of Artificial Intelligence (AI) literacy in teacher education: A scoping review	To examine how the scientific literature conceptualizes AI literacy in relation to teachers' different forms of professional knowledge relevant for Teacher Education (TE).	AI literacy is a rapidly emerging research topic, with interest growing in the past two years, but almost absent in TE. Six main topics: Curriculum development, AI literacy frameworks, teacher attitudes/misconceptions, how to teach with/about AI, professional development, and AI ethics. Two-thirds of papers empirical, one-third conceptual; no classroom observations. AI literacy definition varies widely; often interchangeable with other literacies or concepts like "AI readiness". Only one study explicitly explored AI literacy in TE.

Authors	Title	Purposes	Findings
			Teachers' Professional Knowledge (Aristotelian framework): - Episteme (Theoretical): Explicitly mentioned in conceptual studies, often implicitly captured elsewhere. - Techne (Practical): Less addressed (n=18). Explicit focus on training teachers to teach AI. Implicitly, it often meant adopting digital resources or EdTech. Existing AI resources often fall short for teachers' implementation needs. - Phronesis (Ethical/Professional Judgement): Predominantly addressed as understanding technical configurations of data-driven AI technologies.
Yim (2024)	A critical review of teaching and learning artificial intelligence (AI) literacy: Developing an intelligence-based AI literacy framework for primary school education	To conceptualize AI literacy for young learners by analysing existing theoretical frameworks across educational levels and proposing a new intelligence-based AI literacy framework for primary school students.	Research in primary school AI literacy is underdeveloped but showing recent growth. Theoretical Orientations: Commonly employed Bloom's taxonomy or similar scaffolding progressions (n=4), constructionism (n=4), and theory of computation (n=1). Themes: University-level frameworks broadened from technical to interdisciplinary and ethical. K-12 emphasizes critical thinking and societal impact. Primary school focuses on basic conceptual understanding and ethical awareness via creative pedagogies. Learning Focuses: AI ethics (n=13) is a critical component. Also, computational thinking (n=8), digital literacy (n=7), data literacy (n=7), and interdisciplinary/transdisciplinary content knowledge (n=6). AI literacy is situated at the intersection of digital literacy, data literacy, computational thinking, and AI ethics.
Veldhuis et al. (2025)	Critical Artificial Intelligence literacy: A scoping review and framework synthesis	To identify publications reporting on activities that engage children (ages 5-18) to address the critical implications of AI, examine embedded critical literacy learning objectives, and propose a critical AI literacy framework.	Rise in studies exploring youth's critical reflections on AI's societal/ethical implications over the past three years. Critical implications: Long and Magerko's (2020) categories, such as accountability, bias, and privacy, and inductively emerged implications (harms, identity representation, fairness…) were identified. Proposed Critical AI Literacy Learning Objectives: - Disrupting the commonplace: Analyse/question AI's integration in daily life, challenge preconceptions, study AI's impact on identity/society, envision responsible use. - Considering multiple viewpoints: Analyse differential impacts on groups, seek marginalized voices, reflect on contradictory perspectives. - Focusing on the sociopolitical: Study AI's impact on sociocultural landscape/ power relations, critique unequal power. - Taking action: Question AI creators' processes, analyse design choices, redesign AI technology.

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Authors	Title	Purposes	Findings
Yim & Su (2025)	Artificial intelligence literacy education in primary schools: A review	To offer a comprehensive overview of what constitutes AI literacy education in primary schools, including theoretical frameworks, pedagogical strategies, learning tools, assessment methods, educational outcomes, and challenges.	AI literacy in primary schools is relatively new but showing positive publication trend since 2019. Definition of AI Literacy: Encompasses digital literacy, computational thinking, AI ethics, and critical data literacy. AI ethics should be central. Theoretical Frameworks: Predominantly constructionism (n=8) and the ARCS model of instructional design (n=6). Pedagogical Strategies: Extensive adoption of constructivist pedagogies, especially project-based and programming approaches. Human-agent interaction and generative AI are emerging opportunities. Assessment Methods: Mixed-methods are common. Quantitative (surveys/questionnaires) for behavioural intentions, readiness, knowledge acquisition; Qualitative (interviews, artifacts) for conceptual understanding. Variety of methods like self-assessment surveys and rubric tests. Outcomes: Positive academic, affective, and behavioural outcomes, and course satisfaction in 15/25 studies. Challenges: Ineffective/outdated AI teaching tools, lack of systematic curriculum/measurements, student perceptions/readiness, gender differences.
Zhou et al. (2025)	Defining, enhancing, and assessing artificial intelligence literacy and competency in K-12 education from a systematic review	To understand how to design content, instructions, and assessments for AI integration in K-12 schools. Presented definitions of AI literacy and competency, highlighting need to include self-reflection and emotional aspects.	Identified 13 topics, five instructional designs, and five assessment approaches. Content Design: - Technology (39%): Definitions, history, human vs. computer intelligence, learning from data. - Collaboration (21%): AI in vision, hearing/speaking, reading/writing, thinking/creating, reasoning. - Impact (24%): Social good, future of work, risk. - Self-reflection was NOT addressed in any reviewed article. Instructional Approaches: Learning through experience (10%), design thinking, contextualized learning, controversial discussions, model training and testing. Assessment Approaches: AI literacy test (n=19), self-reported survey (n=19), assessment rubrics (n=11), classroom observations (n=20), interviews (n=20).

4.2.2. AI literacy frameworks

The included studies revealed two major strands in AI literacy framework development: (1) review studies that map and synthesize existing AI literacy frameworks, and (2) framework-building studies that propose new conceptual directions to address gaps in existing models. Yim (2024) reviewed existing AI literacy frameworks across educational contexts, identifying 17 AI literacy frameworks. Importantly, the review shows that AI literacy has evolved beyond its original focus on technical or computer science education and is increasingly positioned as a foundational literacy for all learners, including those without programming backgrounds. The frameworks reviewed were from multiple educational levels: for all educational stages, K–12 education, higher education, secondary schools, and early childhood education. Building on this synthesis, Yim (2024) proposed an intelligence-based AI literacy framework for primary school education. The framework was designed to address limitations in existing models that often overemphasized technical knowledge while insufficiently considering children's developmental needs. Instead, the framework conceptualizes AI literacy as a broader educational capacity that integrates cognitive understanding, practical engagement, ethical awareness, and social dimensions of interacting with AI. By grounding AI literacy within an intelligence-oriented perspective, the framework positions primary school learners not simply as future AI developers but as informed and responsible users who can understand, engage with, and make judgements about AI in everyday life.

In addition, Veldhuis et al. (2025) moved beyond reviewing existing frameworks and proposed a Critical AI Literacy Framework. Through a 10-year scoping review of educational activities, they argued that existing AI literacy approaches insufficiently address critical engagement with AI's broader social consequences. Drawing on critical literacy theory and extending Lewison et al.'s (2002) framework, they synthesized 13 additional learning objectives specifically oriented toward critical AI engagement. Their framework expands AI literacy beyond understanding and using AI to include questioning, critiquing, and transforming AI systems and their social, political, cultural, and ethical implications. The framework further integrates ideas from critical computational literacy and critical digital literacy, positioning learners not only as AI users but also as active interpreters, designers, and agents of change within sociotechnical systems.

These studies, in general, indicate an evolution in AI literacy research: from mapping broad educational competencies across educational levels (Yim, 2024) toward developing more critical, participatory, and transformative models of AI engagement (Veldhuis et al., 2025). Rather than focusing solely on understanding and applying AI, newer frameworks increasingly emphasize agency, reflection, critique, and the capacity to shape AI's role in society.

4.2.3 The development of AI literacy

Out of the eight included studies, three studies examined how AI literacy was developed. These studies suggest that AI literacy education is increasingly characterized by experiential, participatory, and context-based pedagogies that move beyond direct instruction toward active engagement with AI systems and their societal implications.

Zhou et al. (2025) identified five instructional designs that support different dimensions of AI literacy and competency development. Model training and testing help learners understand how AI systems function and expose limitations and bias, strengthening technological understanding and human–AI collaboration. Learning through experience supports students in unpacking the black box of AI processes that are otherwise abstract. Contextualized learning immerses students in authentic situations to develop awareness of AI's societal impact and ethical implications. Controversial discussions encourage students to engage with multiple perspectives and critically examine ethical dilemmas, while design thinking was identified as the most comprehensive approach because it integrates empathy, problem solving, ethical

reflection, AI application, and self-reflection across iterative project cycles.

Focusing specifically on primary education, Yim and Su (2025) found that AI literacy instruction relies on three main learning tools: intelligent agents, software-based environments, and unplugged activities. Intelligent agents such as robots and no-code machine learning tools create interactive and authentic AI experiences; software environments support computational thinking and introductory programming; and unplugged activities promote conceptual understanding of AI without requiring technical expertise.

Similarly, Olari et al. (2023) emphasized active and collaborative learning as dominant pedagogical approaches. AI learning activities were typically described as hands-on, playful, project-based, and learner-centred. Students frequently engaged in collecting, analysing, and using data to train AI models, highlighting the integration of data literacy practices into AI education. Across studies, AI literacy was therefore taught less as content transmission and more as an active process of experimentation, reflection, collaboration, and real-world problem solving.

5. Discussions

Methodological diversity and emerging rigor in AI literacy review research

The methodological diversity across the reviewed studies reflects the interdisciplinary and evolving nature of AI literacy research. The dominant use of PRISMA indicates increasing attention to methodological rigor, transparency, and reproducibility in evidence synthesis (Page et al., 2021). The use of multiple databases such as SCOPUS, Web of Science, and other databases further demonstrates the broad disciplinary scope of AI literacy in education, healthcare, and technology-related fields.

The use of thematic analysis, bibliometric mapping, and framework synthesis suggests that the field remains in an exploratory stage, seeking both conceptual clarity and theoretical grounding. Overall, these findings indicate growing methodological sophistication while emphasizing the need for more standardized and comparable approaches in future AI literacy research.

Complexity in conceptualizing AI literacy and diversity of AI literacy frameworks

Regarding conceptualization and frameworks, the present review highlights the rapid expansion yet conceptual fragmentation of research on AI literacy. While the included studies collectively underscore the importance of equipping individuals with the knowledge and skills to engage with artificial intelligence, they reveal substantial variation in how AI literacy is defined, conceptualized, and operationalized (Laupichler et al., 2022; Sperling et al., 2024).

The conceptualization of AI literacy has evolved from a narrow technical focus toward a more human-centred and socially embedded orientation. A clear convergence can be observed in the widespread adoption of comprehensive models that integrate ethical and social dimensions alongside technical competence. Because of the absence of a unified definition of AI literacy, across the reviewed studies, AI literacy is variously framed as a constellation of related literacies (e.g., digital, data, and computational literacy), a set of measurable competencies, or a form of critical engagement with the socio-ethical implications of AI (Yim, 2024; Veldhuis et al., 2025). This conceptual diversity reflects the inherently interdisciplinary nature of AI literacy but also limits comparability across studies. For instance, some studies adopt a skills-based perspective, emphasizing technical knowledge and application (Kimiafar et al., 2023; Olari et al., 2023), while others extend the construct to include ethical reasoning, critical thinking, and societal awareness (Yim, 2024; Yim & Su, 2025). As a result, AI literacy is best understood not as a fixed construct but as an evolving and context-dependent one. However, Long and Magerko's (2020) framework, adopted in approximately two-thirds of post-2020 studies, signals an emerging consensus around a balanced and multidimensional understanding of AI literacy. The distinction of AI literacy and competency in one article suggests a need to further explore this aspect.

Nevertheless, the field remains theoretically unsettled. Various frameworks have been synthesized to offer insights into AI literacy, complemented with new proposed frameworks as a result of these reviews. This suggests that over time new frameworks could be synthesized with more and maybe different understanding of AI literacy.

Different pathways to develop AI literacy for learners

A review of these studies reveals diverse approaches to the development of AI literacy (Laupichler et al., 2022; Olari et al., 2023). More importantly, the development of AI literacy seems to be a practice-oriented learning process in which students construct understanding through experimentation, critical reflection, collaborative engagement, and solving authentic problems rather than passively receiving knowledge. This aligns with the distinction between AI literacy and AI competency. While AI literacy has increasingly been defined as foundational understanding of AI concepts and ethical use, AI competency extends to the confidence, judgement, self-reflection, and practical capacity to apply AI effectively in different contexts (Chiu, 2025; Zhou et al., 2025). In these studies, the distinction is unclear while AI literary was also conceptualised as ability to use AI. For performance, students need opportunities to observe AI behaviour, experiment with inputs and outputs, and critically reflect on the consequences of AI-generated decisions. This aligns with previous studies, which argue that understanding emerges through active interaction and meaning construction rather than passive reception (Markant et al., 2016; Wiggins et al., 2017). Therefore, instructional approaches such as design thinking, experiential learning, and contextualized problem-solving are particularly effective because they create opportunities for students to transform conceptual understanding into responsible action and adaptive decision-making (McCurdy et al., 2020; Thomas, 2009).

Furthermore, the emphasis on collaborative and contextual learning suggests that AI literacy is increasingly understood as a socio-technical and situated capability rather than an isolated technical skill. This interpretation resonates with recent critiques that challenge techno-solutionist assumptions in AI education. Sperling et al. (2024) argue that AI literacy should not be reduced to technical mastery or measurable competencies detached from practice but should instead support learners' ability to critically evaluate AI within authentic educational and social contexts. Similarly, one review study also emphasizes learners should not only learn to use AI but also develop the capacity to question its ethical, political, and societal implications (Veldhuis et al., 2025).

6. Conclusions and recommendations

6.1. Conclusions

This scoping review of review studies synthesizes the current landscape of AI literacy research through a second-order analysis of eight review studies published between 2020 and 2025. The review provides a comprehensive understanding of how AI literacy has been conceptualized, framed, and developed across educational contexts. The findings indicate that AI literacy is increasingly understood as a multidisciplinary competency that extends beyond technical knowledge to include ethical awareness, critical engagement, and social responsibility. Similar to many emerging educational constructs, AI literacy remains conceptually diverse, with multiple and sometimes overlapping frameworks proposed in the literature. These findings highlight the importance of developing context-sensitive instructional strategies that support learners at different educational levels and backgrounds, ultimately fostering informed, responsible, and critical engagement with AI technologies.

6.2. Implications

Based on the results of this study, three implications are suggested. First, there is an urgent need for foundational core studies that clarify the distinctions between AI literacy and competency, while grounding the construct in robust theoretical frameworks to reduce fragmentation without suppressing contextual variations. Second, instructional strategies should adopt differentiated, context-sensitive approaches,

leveraging design thinking, experiential learning, and contextualized problem-solving, to foster both conceptual understanding and responsible, adaptive action across diverse learner levels and settings. Third, policymakers and educators can prioritise coherent yet flexible curricula and teacher professional development programs that embrace the emergent, multidisciplinary nature of AI literacy, thereby mitigating jingle-jangle fallacies and promoting equitable, effective AI education.

6.3. Limitations and future research directions

This scoping review has several limitations. First, it synthesizes only eight review articles from a single database, SCOPUS, which may not fully capture the breadth and diversity of AI literacy research. Future research should incorporate multiple databases to provide a more comprehensive understanding of AI literacy research. Future studies could also conduct meta-analyses to examine the effectiveness of AI literacy initiatives, pedagogical interventions, and educational outcomes across different context and population. Second, as a review of reviews, the depth of analysis depended on the quality and scope of the included studies, which varied considerably. More importantly, core foundational studies are needed to clearly distinguish between AI literacy and AI competency, and to explore how AI literacy manifests differently across various stakeholder groups, such as students, teachers, professionals, and policymakers. Additionally, empirical investigations into valid and reliable methods for measuring and assessing AI literacy in diverse educational contexts would significantly advance the field.

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Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this manuscript, the authors used NotebookLM and ChatGPT to support content summarization and to improve the clarity and readability of the language. All outputs generated by these tools were carefully reviewed and revised by the authors, who take full responsibility for the integrity and accuracy of the final published article.

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