WHAT LITERACY?
AN INTEGRATIVE REVIEW OF AI EDUCATION IN MIDDLE SCHOOL

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ABSTRACT

Artificial Intelligence (AI) has rapidly advanced over the past year, significantly influencing the conversation about the future(s) of education (Tuomi et al., 2023). At the same time, today's children and youth are growing up in an AI-infused world being the first generation whose education, healthcare, and leisure activities are significantly influenced and mediated by AI-powered applications. This raises considerable expectations for compulsory education to ensure that students of all ages gain an adequate understanding to critically evaluate and engage with AI technologies. Such understanding, also referred to as *AI literacy* (Holmes et al., 2022), has become the focus of a steadily growing number of research initiatives, each with distinct goals and perspectives. *AI literacy* has predominantly been developed within the computer science domain (Sperling et al., 2024) and has strong connections to data literacy or digital literacy (Olari & Romeike, 2021). These connections are particularly visible in various national AI curricula, which predominantly take on a technological perspective by covering AI technologies and applications, including techniques like machine learning and natural language processing (Miao & Shiohira, 2022). At the same time, it is argued that AI technologies often operate autonomously and can adapt according to the context, making them capable of making decisions and actions based on predictions. Therefore, it has been argued, a focus on AI ethics, data biases, surveillance, and the potential impact on employment and sustainable development are pivotal as part of AI literacy (Holmes & Porayska-Pomsta, 2022).

Several literature reviews and syntheses have explored AI literacy in various domains, including K-12 education (eg.., Casal-Otero et al., 2023; Stolpe & Hallström, 2024). However, to the best of our knowledge, previous research rarely specifies how AI literacy should be introduced to students of specific age groups or whether it should be integrated into existing subjects or taught as a standalone subject. The increased engagement in this area, also raises critical questions of *what literacy* emerges in relation to AI and which perspectives on AI literacies are reflected in the scientific literature.

Aim and research questions

This extended abstract presents preliminary findings from a literature review conducted as part of the Swedish Research Council-funded research project "AI Literacy for Swedish Primary Education – a Co-design Project."[1] The project develops a scientific foundation for AI literacy in social science and STEM classrooms. Middle school is in focus as the use of digital (AI) technology begins to boom in the lives of 9-13-year-old students, needing proper guidance. The aim of this study is to refine the scope and essence of AI literacy relevant for middle school students while striving to develop new models and approaches to this emerging research field. We address this aim through the following research questions:

1. What is the current state of AI literacy relevant for 9–13-year-old-students?

2. What characterises the emerging literacy(ies)?

In this study we argue that AI literacy can be understood as a social construct emerging from the many complex relationships between social, material and semiotic resources and that it serves diverse strategic purposes in different political and organisational contexts (Selwyn, 2024). To methodologically advance and critically explore the current nature of AI literacy in the scientific literature, with a focus on middle school education we decided to adopt the GeST *framework* by (Lupton & Bruce, 2010) originally developed for information literacy. The GeST framework approaches literacy from three interlinked perspectives: (1) as a set of *generic* and individual skills, (2) as *situated* in social practices, or (3) as *transformative* for both individuals and society. Broadly speaking, the generic perspective captures a more behaviourally oriented form of literacy, the situated perspective emphasises sociocultural dimensions, and the transformative perspective focuses critically on emancipation.

Method: Integrative review

In response to our research questions, we conducted an integrative review intended to evaluate the literature in a manner that could both advance the knowledge of AI literacy in the context of middle school education *and* generate new approaches and frameworks (Snyder, 2019). Thus, an integrative review is commonly applied to address emerging topics and to assess, critique and synthesise the literature for new theoretical perspectives and dimensions. In line with Whitemore & Knapfl's recommendation (2005), the goal is to critically address and examine the main ideas and relationships in a transparent and structured way. Consequently, this puts focus on methodological rigour, rather than following specific standards.

 The literature search was done on January 10th, 2024, in Scopus, a well-recognised bibliometric database, using the search query ("AI literacy" OR "artificial intelligence

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[1] https://www.vr.se/swecris.html#/project/2022-03553_VR

literacy") AND (K-12 OR middle OR primary). Out of the 80 identified peer-reviewed papers (journal articles and proceedings), 20 were excluded before screening due to non-compliance with the initial inclusion criteria (English). A two-stage screening process was then conducted, incorporating added exclusion criteria, ultimately resulting in 24 included papers for analysis (Figure 1).

During the final stage of the analysis the 24 papers underwent a more comprehensive analysis in relation to the GeST framework. As the generic, situated and transformative perspectives could be found within one paper, we needed to develop a fine-grained analytical lens. Inspired by Bruce and Lupton (2010) we selected three propositions: (1) AI literacy is…, (2) AI literacy is important because…, and (3) AI literacy is being taught and learnt through… (Table 2). Consequently, each article was considered with nine possible mappings in mind.
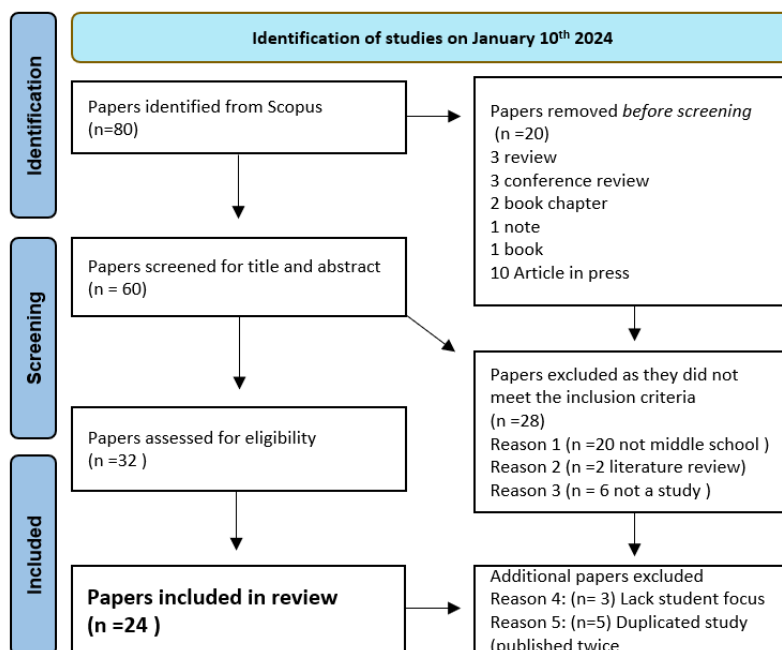

Identification of studies on January 10th 2024

Identification

Papers identified from Scopus (n=80) → Papers removed *before screening* (n =20)
3 review
3 conference review
2 book chapter
1 note
1 book
10 Article in press

Screening

Papers screened for title and abstract (n = 60)

Papers excluded as they did not meet the inclusion criteria (n =28)
Reason 1 (n =20 not middle school)
Reason 2 (n =2 literature review)
Reason 3 (n = 6 not a study)

Papers assessed for eligibility (n =32)

Included

Papers included in review (n =24) → Additional papers excluded
Reason 4: (n= 3) Lack student focus
Reason 5: (n=5) Duplicated study (published twice

Figure 1. Study selection

Preliminary findings

In response to our first research question, the results indicate that AI literacy is growing in interest in the scientific community with almost 3/5 of the contributions (n=15) published only the past two years and with an even distribution between conference proceedings and journal papers. AI in the context of K-12 education is a subject of interest in many parts of the world, with the dominating authors countries United States (n=10) and China (n=5), and with one study each from Austria, Spain, Belgium, Malta, Denmark, Greece, Finland, Canada and the UK. While the conceptualisation around AI literacy is still vague, we found overarching topics related to: 1. The development of teaching materials (n=11), consisting of various

interventions that develop digital and analogue methods for teaching with and about AI; 2. Curriculum Development (n=6), focusing on what students should know about AI; 3. Attitudes and Competencies (n=5), measuring teachers' and students' attitudes toward AI; and 4. Professional Development (n=2), addressing the professional development of educators in the context of AI literacy.

The GeST mapping, which is still a work in progress, indicates that the generic, situated, and transformative perspectives emerge in relation to the three distinct propositions across the different papers. A generic perspective is reflected in most of the papers (n=35). The situated perspective (n=16) and the transformative perspectives are reflected much less frequently (n=17). Several of the papers fall into more than one category and very few papers adhere to only one of the perspectives. Thus, on a general level, the GeST mapping shows that AI literacy in middle school education emerges primarily as a generic set of measurable skills related to theoretical knowledge about how AI works and where it is applied. These skills are expressed as something that can be learned by individuals independent of context and assessed through quantitative methods. While theoretical knowledge and skills related to AI are fundamental, they are not enough to fully engage in the conversation of how to use and develop AI that serves the interests of all people. In other words, a generic perspective on AI literacy risks limiting students understanding and agency in relation to AI. It also risks limiting learning and teaching to things that are predictable and known, which is not the case when it comes to the rapid development and implementation of AI technologies. For those reasons, situated and transformative perspectives, which consider the contextual, material, and social aspects of teaching and learning and foster critical thinking, should be given greater consideration. From a methodological standpoint, our adapted GeST framework proved instrumental in highlighting the current emphasis on different aspects of AI literacy. It can be used in future research to capture and analyse the various AI literacies being introduced worldwide and to serve as a tool for designing AI curricula that promote critical thinking and active citizenship among middle school teachers and students.

References

Casal-Otero, L., Catala, A., Fernández-Morante, C., Taboada, M., Cebreiro, B., & Barro, S. (2023). AI literacy in K-12: A systematic literature review. *International Journal of STEM Education*, *10*(1). https://doi.org/10.1186/s40594-023-00418-7

Holmes, W., Persson, J., Chounta, I. A., Wasson, B., & Dimitrova, V. (2022). *Artificial intelligence and education: A critical view through the lens of human rights, democracy and the rule of law*. Council of Europe.

Holmes, W., & Porayska-Pomsta, K. (2022). *The Ethics of Artificial Intelligence in education: Practices, challenges, and debates*. Taylor & Francis.

Lupton, M., & Bruce, C. (2010). Windows on information literacy worlds: Generic, situated and transformative perspectives. *Practising information literacy: Bringing theories of learning, practice and information literacy together*, 3-27.

Miao, F., & Shiohira, K. (2022). K-12 AI curricula. *A Mapping of Government-Endorsed AI Curricula*.

Olari, V., & Romeike, R. (2021). Addressing AI and Data Literacy in Teacher Education: A Review of Existing Educational Frameworks. *ACM International Conference Proceeding Series*. ACM International Conference Proceeding Series. https://doi.org/10.1145/3481312.3481351

Selwyn, N. (2024). On the Limits of Artificial Intelligence (AI) in Education. *Nordisk Tidsskrift for Pedagogikk Og Kritikk*, *10*(1). https://doi.org/10.23865/ntpk.v10.6062

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of business research*, *104*, 333-339.

Sperling, K., Stenberg, C.-J., McGrath, C., Åkerfeldt, A., Heintz, F., & Stenliden, L. (2024). In search of artificial intelligence (AI) literacy in teacher education: A scoping review. *Computers and Education Open*, *6*, 100169. https://doi.org/10.1016/j.caeo.2024.100169

Stolpe, K., & Hallström, J. (2024). Artificial intelligence literacy for technology education. *Computers and Education Open*, *6*, 100159. https://doi.org/10.1016/j.jbusres.2019.07.039

Tuomi, I., Cachia, R., & Villar-Onrubia, D. (2023). *On the futures of technology in education: Emerging trends and policy implications*. Publications Office of the European Union. https://doi. org/10.2760/079734

Whittemore, R., & Knafl, K. (2005). The integrative review: Updated methodology. *Journal of Advanced Nursing*, *52*(5), 546–553. https://doi.org/10.1111/j.1365-2648.2005.03621.x