

AI literacy as intercultural competence: an inclusive framework for early childhood in the post-digital age

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Abstract: This paper examines the integration of Artificial Intelligence into educational environments, with a specific focus on early childhood and the need for a critical and inclusive approach. The article, starting from an analysis of the main operational characteristics of large language models (LLMs), highlights specific risks for children: the anthropomorphisation of conversational agents, overexposure to algorithmic responses deemed plausible, the monetisation of children's lives through datafication, and disparities in access that may reinforce cultural and socio-economic inequalities. By exploring the concept of AI Literacy, understood as a multidimensional literacy that combines algorithmic understanding, awareness of bias, the ability to critically validate outputs, and a focus on empowerment, an inclusive and intercultural pedagogical framework is proposed that integrates a media education perspective and the construct of critical digital competence, emphasising the need to design technologies that are sensitive to cultural differences and to safeguard the cognitive, emotional and social development of minors.

Keywords: Artificial Intelligence; Early Childhood; AI Literacy, Intercultural Competence, Datafication.



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1. Introduction

The spread of Artificial Intelligence (AI) systems within educational and social contexts in recent years forms part of a broader process of platformisation that has become entrenched in the governance structures and everyday practices of entire sectors of our society (Van Dijck et al., 2018). The rapid transition currently underway towards models of communication and knowledge production that integrate chatbots such as Gemini, ChatGPT or Claude is challenging established educational practices, which it is essential to reflect upon. These are, in fact, systems based on large language models (LLMs) that use algorithms and statistical models to analyse vast amounts of data and identify patterns from which to extract linguistically plausible information. Unlike other models, LLMs not only introduce predictive capabilities (e.g. drawing conclusions and adapting to a given user's

preferences and online behaviour) but have also introduced generative capabilities such as the production of text, images, sounds and videos. Generative AI represents the most recent development available to everyone and works by combining and reworking the vast amounts of data with which it has been trained, identifying recurring patterns through a conversational communication system with the user. LLMs, in fact, lack any form of metacognition but generate probabilistic predictions without any intrinsic evaluation of the content. It is in this crucial aspect that the difference lies between human reasoning and the processing carried out by AI systems, in which apparent coherence and linguistic plausibility correspond to statistical processes rather than to concepts or correspondences with concrete reality. Recent research has coined and introduced the concept of epistemia to describe the condition in which linguistic plausibility replaces epistemic evaluation, creating in the user of these tools the sensation of 'knowing' without having actually carried out a critical analysis of the outputs generated by AI (Quattrocioni et al., 2025). This means that fluent and formally correct responses are regarded as true and grounded, whilst they are merely linguistic representations resulting from textual probabilistic correlations. The same authors, by breaking down the process of human judgement and comparing it with the functioning of LLMs, have also highlighted that when humans are in doubt about a topic, they may refrain from giving their opinion, whereas language models tend to generate responses that favour hallucinations (Quattrocioni et al., 2026). Added to this is the conversational nature of AI systems, which simulate natural human language to facilitate artificial communication via voice or text, offering immediate responses but risking the impoverishment of the social and emotional dimensions of human communication, particularly in educational contexts (Selwyn, 2024). These operational mechanisms necessitate an evaluation of these platforms, considering both the opportunities they offer and the critical issues they entail, particularly in fields where practices require informed and responsible decision-making skills, such as the educational context, particularly early childhood education (Adamoli & Emanuel, 2025). To address these epistemological and educational challenges, the CREDDI research group at eCampus University¹ has developed the ARISE-AI framework, a human-centred model designed to identify and guide the use of AI in social and educational contexts (Adamoli et al., 2026a). The theoretical framework situates the issues within the international and national debate to promote a person-centred, equitable, transparent and ethically oriented adoption of AI. The framework integrates three main dimensions: affordance-in-practice (the situated possibilities for using AI in social and educational activities); professional capability (the professional ability to use AI strategically); and sentiment (the emotional and attitudinal responses of educators and teachers that influence its adoption). It is against this backdrop that the TEACH-AI (Transformative Educational Approaches for Civic and Human-centred AI) project is situated, an action research initiative exploring the participatory and responsible integration of generative Artificial Intelligence tools into socio-educational services (Adamoli et al., 2026b). This paper,

¹ The working group is composed of Federica Emanuel, Marco Rondonotti, Matteo Adamoli, Michele Marangi, and Paolo Raviolo.

drawing on the theoretical perspectives of the framework, reflects on the concept of AI literacy itself in light of the transformations brought about by Artificial Intelligence, defining it as an increasingly relational and critical approach (Ranieri, 2024) that encompasses the ability to decode the affective and ideological dimensions inherent in generative technologies for children and to support children in developing genuine autonomy within digital ecosystems, rather than merely exposing them to such technologies (Livingstone & Sefton-Green, 2025). This proposal places the quality of mediation between adults and children, rather than the device itself, at the heart of any meaningful approach to children's digital rights.

2. Early childhood as a privileged observatory on post-digital languages

The introduction of Artificial Intelligence systems within such technologies—such as messaging systems, entertainment applications or simply search engines—has highlighted certain key issues related to the governance of these processes, particularly within educational ecosystems that face challenges deemed crucial for the growth and development of younger generations: the redefinition of educational objectives, the analysis of the power structures that control cognitive infrastructures, and the temporal conflict between technological acceleration and the biological rhythms of development. In a post-digital context where access to information and data processing are delegated to automated systems, the traditional educational model based on classical digital literacy has become obsolete, and the development of critical co-agency has become necessary (Marangi, 2026). Datafication has also transformed childhood into a monetisable data stream via digital platforms owned by large corporations which, through the use of AI systems, are acting as cognitive infrastructures. If children construct their identity within architectures designed to maximise engagement and data extraction, the risk is the creation of a predetermined environment that can condition the choices of the child and their caregivers from the earliest years of life (Barassi, 2021). Children, in fact, lack the resources to decode the predictive logic of the algorithmic systems typical of surveillance capitalism (Zuboff, 2019), and a new architecture of rights is required that encompasses the safeguarding of cognitive, emotional and social development, the active and critical participation of minors in digital spaces, and the transparency of the infrastructures that mediate their growth (Livingstone & Third, 2017). Furthermore, perhaps the most radical challenge is that linked to the concept of time. There is, in fact, an unbridgeable gap between the speed at which technology spreads and the need for extended periods of time for cognitive and emotional development. The clash between technological acceleration and the individual's educational development creates a short-circuit those risks compromising certain cognitive functions, such as neural plasticity and the capacity for deep concentration – essential foundations for the development of critical and independent thinking (Gallese, 2026). These processes require the development of AI literacy that considers the opportunities and risks associated with the way conversational AI, based on natural language, is presented to children—namely, as a genuine relational partner. Among the opportunities, one can include support for linguistic development, interactive engagement and the stimulation of curiosity. With regard to the risks, it is useful to include: the process of anthropomorphisation, in which

children, if unsupervised, may attribute intentions, emotions and moods to AI systems, confusing linguistic simulation with relational reality; and overexposure to algorithmic responses, in which children in the symbolic construction phase may regard AI as an authoritative source. The various reference frameworks developed to address these challenges, such as the AI Competency Framework for Students (UNESCO, 2024) or DigComp 3.0: European Digital Competence Framework (Cosgrove & Cachia, 2025), shift the focus from mere technical skills to citizenship skills, emphasising safety and what it means to grow up and be educated within a society governed by algorithmic processes. Viewed from this perspective, early childhood can become a privileged vantage point from which to examine the transformations of our time, as it allows us to highlight the power asymmetries that often remain hidden in analyses centred on adults. Viewing the post-digital world through a child's eyes means unmasking those mechanisms of conditioning which, in adult life, we have now normalised and accepted as inevitable. This awareness therefore requires us to develop new skills. Algorithmic literacy should be understood as a genuine civic competence, necessary for navigating the public sphere. In this context, prompt engineering is not merely an IT technique but becomes a technical-educational practice. Finally, it is essential to promote a critical understanding of the limits and responsibilities of AI, shifting educational mediation from a logic of restrictive control to one of informed guidance.

3. AI and Early Childhood: An Inclusive and Intercultural Framework

The integration of Artificial Intelligence into Early Childhood Education (ECE) contexts does not constitute a mere instrumental updating of pedagogical practice; rather, it delineates a structural transformation of learning environments that calls for the development of a rigorously inclusive and intercultural pedagogical framework (Salas-Pilco, Xiao & Oshima, 2022). The developmental window spanning ages 3 to 8 represents a particularly sensitive phase: the cognitive, emotional, and identity-related architectures of the subject are constructed through relational and symbolic processes that intertwine with the technological dimension in a pervasive and often unconscious manner (Barassi, 2021). In the post-digital condition of childhood, in which the boundaries between online and offline are now structurally indistinguishable, children learn and grow immersed in algorithmic ecosystems that shape their cognitive and relational experiences long before they have developed the critical tools to decode them (Marangi, 2026). From a theoretical standpoint, the primary epistemological grounding of this framework lies in Vygotskian social constructivism, within which AI can be conceptualised as a non-human scaffolding agent capable of dynamically mediating the child's Zone of Proximal Development (ZPD), facilitating the critical transition from other-regulation to self-regulation (Cipi & Cipi, 2025). To reduce AI's role to that of a mere adaptive tutor, however, would be to disregard the deeper implications tied to the power structures governing digital cognitive infrastructures (Van Dijck, Poell & De Waal, 2018). Children's media practices in the early stages of development are profoundly shaped by family contexts and by the choices of significant adult figures (Mascheroni, 2025), which renders the mediating role of parents and educators decisive, not merely as technical managers of tools but as agents capable of critically

orienting young children's digital experience (Marangi, 2023). In this direction, frameworks such as the UNESCO AI Competency Framework for Students (2024) and DigComp 3.0 (Cosgrove & Cachia, 2025) redirect attention from narrow digital literacy towards the competencies of critical and reflective citizenship. On the intercultural plane, the embedding of AI technologies within socially heterogeneous contexts raises systemic challenges that transcend purely infrastructural concerns. The ontological limitation of current AI systems resides in their capacity to process only so-called “surface culture”, expressed through visible traditions, manifest behaviours, and codifiable linguistic structures, while consistently failing to apprehend “deep culture”: that complex constellation of values, beliefs, and affective assumptions that governs genuine intercultural interaction, as illustrated by the cultural iceberg model (Obari, 2025). For learners belonging to linguistic or ethnic minorities, the discrepancies between their mother tongues and the standardised instructions embedded in AI tools can generate significant cognitive barriers, making child-focused technological design imperative, one capable of embracing cultural difference rather than assimilating it into predetermined dominant models (Salas-Pilco, Xiao & Oshima, 2022). Scholarship on digital childhood further demonstrates that inequalities in device access intersect with broader cultural and linguistic inequalities, producing forms of exclusion that risk becoming entrenched at an early age and durably conditioning subjects' developmental trajectories (Cappello & Ranieri, 2026). Persistent disparities in digital infrastructure additionally risk exacerbating the socioeconomic divide, relegating learners from marginalised communities to the role of passive consumers rather than active co-creators of knowledge (Cipi & Cipi, 2025). When the child constructs their identity within architectures designed to maximise engagement and data extraction, the risk emerges of a pre-determined environment capable of conditioning the subject's choices from the earliest years of life. A new architecture of rights is required (Livingstone and Third (2017): one encompassing the safeguarding of cognitive and emotional development, the active and critical participation of minors in digital spaces, and the transparency of the infrastructures that mediate growth. It appears necessary to foster, from early childhood onwards, a form of critical co-agency that places the child in a position to consciously inhabit post-digital space (Marangi, 2026), an endeavour that presupposes the centrality of active family and educational community involvement in the governance of digital media for children (Mascheroni, 2025). The construction of an inclusive and intercultural framework for ECE cannot therefore disregard the need for explicit ethical guidelines that align AI's affordances with the principles of equity, the safeguarding of cultural identity, and the holistic development of the child, placing the quality of the educational relationship, rather than the technological device, at the centre of every pedagogically significant proposition (Selwyn, 2024; Cipi & Cipi, 2025). Only by embedding explicit ethical principles into the design and deployment of technologies can AI be ensured to function as a catalyst for educational equity, enriching early childhood experience without ever supplanting pedagogical intentionality and the irreplaceable quality of interpersonal connection.

4. AI Literacy as Intercultural Competence

AI Literacy constitutes, within the contemporary educational landscape, a multidimensional construct that substantially exceeds the simple acquisition of technical-instrumental skills, emerging as an indispensable vector for the development of Intercultural Communicative Competence (ICC) (Sultan, Dautova & Dalle, 2025). From this perspective, AI Literacy encompasses at least four essential and interdependent dimensions: deep conceptual understanding of algorithmic mechanisms; structured ethical awareness of the biases and power dynamics embedded in generative systems; the capacity for critical validation of AI-produced outputs; and an empowerment orientation that promotes agentive and reflective engagement with technology (Ranieri, 2024; Sultan, Dautova & Dalle, 2025). Quantitative studies demonstrate a direct and statistically significant correlation between the conscious use of AI and the development of intercultural competencies: AI use operates as a strong predictor of ICC (path coefficient $\beta = .292$), an effect further mediated by enjoyment and intrinsic motivation in technology-based learning, consistent with theories associating positive affect with an expanded disposition towards cultural exploration (Sultan, Dautova & Dalle, 2025). Empirical research additionally confirms that AI Literacy and cultural literacy jointly account for 23.7% of the variance in intercultural communicative competence, while simultaneously revealing notable gender asymmetries: male students frequently excel in the technical dimension, whereas female students demonstrate more pronounced socio-cultural competencies, a dichotomy that demands equitable pedagogical approaches, supported by strategies such as peer coaching and cooperative learning (Sultan, Dautova & Dalle, 2025). Experimental investigations of the hidden states of models reveal that, although neural networks internally encode sociolinguistic traits and cultural differentiations, such nuances rarely become visible in the final textual output, generating an illusion of cultural neutrality that in reality reproduces Eurocentric and Anglophone rhetorical norms (Jackson, Li & Edelstein, 2025). As evidenced by Quattrociocchi, Capraro, and Perc (2025) in their analysis of the epistemological fault lines between human and artificial intelligence, the linguistic plausibility of LLMs can produce a condition of “epistemia”, in which the user perceives a sense of knowing without having conducted any genuinely critical analysis of the generated outputs, a risk that is particularly acute in intercultural learning contexts, where relational authenticity is constitutive of the educational process itself. This phenomenon is rooted in AI systems' tendency to privilege algorithmic optimisation processes, excelling in “exploitation” logic at the expense of “exploration” logic, the domain in which creativity, empathy, and ethical judgement form the substrate of authentic intercultural communication (Obari, 2025). The passive use of generative tools further exposes learners to the risk of “cognitive debt”, with measurable reductions in neural connectivity and an early decline in critical reasoning capacities, as documented in neurophysiological studies conducted via electroencephalography (Obari, 2025). To overcome these limitations and construct an authentically intercultural AI Literacy, advanced theoretical frameworks propose integrating Bennett's Developmental Model of Intercultural Sensitivity (DMIS) within the pedagogical architecture of AI-assisted learning. This approach aims to guide

learners from ethnocentric stages, characterised by denial, defence, and minimisation of cultural differences, towards ethnorelative stages of acceptance, adaptation, and integration, sustained by immersive environments, generative role-play, and simulative scenarios that foster decentred perspective-taking (Chorfi, 2026). The construct of AI Literacy is thereby configured not as an isolated technical competence but as an integrated dimension of global citizenship, capable of combining instrumental mastery with critical reflexivity regarding the systems of meaning that technologies convey. An operative paradigm in this regard is provided by the AMRIL model (AI-Mediated Reflective Intercultural Learning), which transforms AI output into a pedagogical reflective mirror: by asking students to closely examine the discrepancies, omissions, and pragmatic deviations of algorithmic output, learners are guided to externalise and deconstruct their own latent cultural biases, evolving towards a “Culturally Driven Learning” (CDL) approach that restores centrality to the agency of the learner (Chorfi, 2026). A critical approach to digital media must take root well before the upper stages of formal schooling, establishing itself in the everyday practices of families, educational services, and communities, in accordance with an ecological model of media education that values continuity across the different contexts of children's lives (Cappello & Ranieri, 2026). At the international level, both the UNESCO AI Competency Framework for Students (2024) and DigComp 3.0 (Cosgrove & Cachia, 2025) converge in identifying the capacity to critically interrogate algorithmic sources as an essential civic competence for the twenty-first century. Only through this level of critical awareness, one that combines technical mastery, cultural sensitivity, and ethical reflexivity, can AI be ensured to become an authentic instrument of intercultural emancipation rather than a vector of cultural homogenisation, preserving the authenticity of human connections in the construction of a responsible and genuinely global citizenship (Obari, 2025; Ranieri, 2024).

5. Conclusions

The reflections developed in this paper open a range of research perspectives that warrant systematic exploration in the years ahead. A first direction concerns the empirical study of algorithmic bias in AI systems designed for or directed at children. Whilst the literature has already rigorously documented how language models reproduce and amplify structural inequalities related to race, gender, and social class in adult contexts (Noble, 2018; Eubanks, 2018), the specific impact of such distortions on the processes of identity formation and cultural construction in pre-school and school-aged children remains largely unexplored. A second line of development concerns the design and evaluation of intercultural AI Literacy tools calibrated to different developmental stages. Existing frameworks tend to presuppose an adult or adolescent subject already in possession of consolidated metacognitive competencies, whereas early childhood contexts demand radically different approaches, grounded in play, narrative, and embodied mediation (Bers, 2018). Thirdly, there is an urgent need to develop longitudinal research methodologies capable of detecting the long-term effects of early exposure to conversational AI systems on the development of intercultural and relational

competencies, integrating neuroscientific, pedagogical, and sociological perspectives (Williamson & Eynon, 2020). Finally, a theoretically open question concerns the juridical and pedagogical status of the "datafied child" (Lupton & Williamson, 2017): to what extent do the algorithmic profiles constructed during childhood condition a subject's future educational and cultural opportunities? Addressing this question requires not only empirical research, but the forging of new alliances between the educational sciences, critical computing, and children's rights policy.

References

- Adamoli, M., & Emanuel, F. (2025). The TEACH-AI project: Co-designing Practices for Socio-Educational Services. *Journal of Inclusive Methodology and Technology in Learning and Teaching*, 5(3), 1-9.
<https://inclusiveteaching.it/index.php/inclusiveteaching/article/view/391>
- Adamoli, M., Emanuel, F., Marangi, M., & Rondonotti, M. (2026a). ARISE-AI: rilevare e orientare le pratiche didattiche con l'Intelligenza Artificiale in una prospettiva human-centered. *Research Trends in Humanities Education & Philosophy*, 13(1), 35-50. <https://doi.org/10.6093/2284-0184/13131>
- Adamoli, M., Emanuel, F., Marangi, M., Rondonotti, M., & Raviolo, P. (2026b). AI in education: Evidence from cluster-based profiling of social educators and teachers in Italy. *Italian Journal of Educational Technology*.
<https://doi.org/10.17471/2499-4324/1589>
- Barassi V. (2021). *I figli dell'algoritmo. Sorvegliati, tracciati, profilati dalla nascita*. Luiss University Press.
- Bers, M. U. (2018). *Coding as a playground: Programming and computational thinking in the early childhood classroom*. Routledge.
- Cappello, G. & Ranieri, M. (2026). *Infanzie digitali. Prospettive socioeducative e mediazione didattica nello zerosei*. Mondadori.
- Chorfi, F. (2026). Teaching British civilisation to EFL learners in the AI era. *Journal of Afro-Asian Studies*, 9(28), 36–50.
- Cipi, E., & Cipi, E. (2025). AI tools in early childhood education: Opportunities, challenges and implications. *Preprints.org*.
- Cosgrove, J., & Cachia, R. (2025). *DigComp 3.0: European digital competence framework*. Publications Office of the European Union.
- Eubanks, V. (2018). *Automating inequality: How high-tech tools profile, police, and punish the poor*. St. Martin's Press.
- Gallese, V. (2026). *Il sé digitale. Dai neuroni specchio alla mediazione tecnologica*. Raffaello Cortina Editore.
- Jackson, P., Li, R., & Edelstein, E. (2025). *Nationality encoding in language model hidden states: Probing culturally differentiated representations in persona-conditioned academic text*. arXiv preprint.
- Livingstone, S., & Third, A. (2017). Children and Young People's Rights in the Digital Age: An Emerging Agenda. *New Media & Society*, 19(5), 657-670.
- Lupton, D., & Williamson, B. (2017). The datafied child: The dataveillance of children and implications for their rights. *New Media & Society*, 19(5), 780–794.
- Marangi, M. (2023). *Addomesticare gli schermi. Il digitale a misura dell'infanzia 0–6*. Scholé Morcelliana.
- Marangi, M. (2026). *IA, Infanzia e algoritmi. Crescere e apprendere nel postdigitale*. Edizioni Junior.
- Mascheroni, G., Saeed, M., Valenza, M., Cino, D., Dreesen, T., Zaffaroni, L. G. e Kardefelt-Winther D. (2021). *La didattica a distanza durante l'emergenza COVID-19: l'esperienza italiana*. Centro di Ricerca Innocenti dell'UNICEF 2021.

- Mascheroni, G. (2025). *Per i bambini. Le sfide di IA, algoritmi, media digitali ai diritti dell'infanzia*. Mondadori.
- Noble, S. U. (2018). *Algorithms of oppression: How search engines reinforce racism*. NYU Press.
- Obari, H. (2025). AI and educators in partnership: Transforming English language assessment and cross-cultural competence with a hybrid model. *The Aoyama Journal of Economics*, 77(4), 51–71.
- Quattrociocchi, W., Capraro, V., & Perc, M. (2025). *Epistemological fault lines between human and artificial intelligence*. arXiv preprint.
- Quattrociocchi, W., Capraro, V., & Marcus, G. (2026). Statistical approximation is not general intelligence. *Nature*, 650/8102, 792-792.
- Ranieri M. (2024). *Scuola e Intelligenza Artificiale. Percorsi di alfabetizzazione critica*. Carocci editore.
- Salas-Pilco, S. Z., Xiao, K., & Oshima, J. (2022). Artificial intelligence and new technologies in inclusive education for minority students: A systematic review. *Sustainability*, 14(20), 13572.
- Selwyn, N. (2024). On the Limits of Artificial Intelligence (AI). *Education*, «Nordisk tidsskrift for pedagogikk og kritikk», 10/1, 3-14.
- Sultan, Y., Dautova, G., & Dalle, J. (2025). Examining the relationship among artificial intelligence literacy, cultural literacy, and intercultural communication proficiency of philology students. *Journal of Ethnic and Cultural Studies*, 12(5), 345–362.
- UNESCO (2024). *AI competency framework for students*. UNESCO Publishing.
- Van Dijck, J., Poell, T., & De Waal, M. (2018). *The platform society: Public values in a connective world*. Oxford university press.
- Williamson, B., & Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education research. *Learning, Media and Technology*, 45(3), 223–235.
- Zuboff, S. (2019). *The age of surveillance capitalism*. PublicAffairs.