International Journal of Digital Literacy and Digital Competence
Volume 16 • Issue 1 • January-December 2025

AI Literacy in Higher Education:
A Systematic Approach to Questionnaire Development and Validation

Maria Ranieri
https://orcid.org/0000-0002-8080-5436
University of Florence, Italy

Gabriele Biagini
https://orcid.org/0000-0002-6203-122X
University of Florence, Italy

Stefano Cuomo
https://orcid.org/0000-0003-3174-7337
University of Florence, Italy

ABSTRACT

This paper presents the development, refinement, and validation of the Critical Artificial Intelligence Literacy Scale, an instrument designed to measure artificial intelligence literacy across four dimensions: knowledge-related, operational, critical, and ethical. The initial version of the questionnaire, based on a robust theoretical framework and expert consultation, included 40 items and was tested with 57 doctoral students. It demonstrated strong psychometric properties (comparative fit index = 0.946, Tucker-Lewis index = 0.92) but showed limitations such as item redundancy (α = 0.947) and low performance of general items. To address these issues, the questionnaire was refined to a concise 24-item version. The revised instrument was evaluated using a sample of 314 first-year student teachers. Exploratory and confirmatory factor analyses confirmed a four-factor structure, with each dimension demonstrating strong reliability (Cronbach's alpha ranging from 0.838 to 0.912) and excellent model fit indices (comparative fit index = 0.960, root mean square error of approximation = 0.0441). The results validate the Critical Artificial Intelligence Literacy Scale as a reliable and efficient tool for assessing artificial intelligence literacy in educational settings.

KEYWORDS

Artificial Intelligence, AI Literacy, Scale Development, Assessment, Higher Education

INTRODUCTION

Artificial intelligence (AI) is rapidly permeating multiple domains of daily life (Chiu et al., 2024; Kong et al., 2024). According to the most recent edition of the United Nations' "Activities on Artificial Intelligence Report" (2023), approximately 400 projects across the United Nation system are based on the use of AI applications, with initiatives ranging from forecasting food crises and measuring water efficiency to locating schools via satellite data and implementing programs on HIV/AIDS. As AI technologies become increasingly present in our societies, the need for individuals to understand their features and potential—not only in terms of technical aspects but also through the critical evaluation of their broader societal implications—is becoming ever more relevant. In this regard, AI literacy,

DOI: 10.4018/IJDLDC.388469

generally understood as the ability to comprehend, critically assess, and responsibly engage with AI technologies, is seen by both international bodies (European Commission, 2018; Organisation for Economic Co-operation and Development, 2021; United Nations Educational, Scientific and Cultural Organization, 2021) and researchers (Biagini et al., 2024; Gašević et al., 2023; Selwyn, 2022) as a key element in responding to new challenges through the development of individuals' awareness of AI and by encouraging a more informed approach to the digital transformation of our lives. In particular, Miao et al. (2021) highlighted AI literacy as a key component of digital competence frameworks, emphasizing the necessity for equipping individuals with the ability to interact with AI ethically and effectively. Similarly, the Organisation for Economic Co-operation and Development (2021) underscored the importance of AI literacy in fostering informed decision-making, critical thinking, and responsible digital citizenship. The European Commission (European Commission, 2018) further supported this perspective by integrating AI literacy within its digital education policies, advocating that AI-related skills are essential for both students and professionals in the 21st century. Beyond institutional perspectives, academic research has extensively discussed the societal and educational implications of AI literacy. For instance, Long and Magerko (2020) highlighted that AI literacy is a crucial competency for the future workforce, as it enables individuals to collaborate effectively with AI systems rather than being displaced by them. Gašević et al. (2023) further emphasized the need for AI literacy to be an integral part of education, arguing, that without adequate understanding, individuals may struggle to navigate AI-driven environments responsibly. These contributions collectively reinforce the notion that fostering AI literacy is fundamental for preparing individuals to engage meaningfully and critically with AI technologies, thereby supporting a more informed and conscious approach to digital transformation. Focusing on the educational sector, we are witnessing the proliferation of guidelines on AI for academic teaching and learning (Jiao et al., 2024). Generally, these guidelines aim to provide guidance on the appropriate uses of AI, mostly generative AI, for educational purposes, and AI literacy is commonly mentioned as a fundamental strategy to sustain aware uses of AI applications (Biagini, 2025; Sabzalieva & Valentini, 2023). Essentially, in educational contexts, AI literacy is crucial to prepare teachers and students to critically adopt AI technologies for teaching and learning. From the teachers' perspective, AI literacy enables educators to incorporate AI tools in pedagogically meaningful ways while maintaining control over their courses (Tlili et al., 2023; United Nations Educational, Scientific and Cultural Organization, 2024). For instance, a teacher may allow students to use generative AI for brainstorming and developing preliminary ideas for a project but prohibit its use for drafting the final submission. Additionally, educators may require students to provide short descriptions of how they use AI in their work to ensure transparency and alignment with course policies. Teachers can also leverage AI for instructional design, such as in creating lecture slides or infographics, provided they verify the accuracy and fairness of AI-generated content before presenting it to students (Ding et al., 2024; Sperling et al., 2024). From the students' perspective, AI literacy is equally essential in ensuring responsible and ethical AI use in their learning processes. For instance, if an instructor allows students to use AI applications only for generating initial ideas, students should not employ these applications to fully produce their assignments. Moreover, students bear full responsibility for verifying the accuracy of AI-generated content, ensuring that it aligns with academic integrity principles and does not constitute plagiarism (Dwivedi et al., 2023). To illustrate, a student using AI to generate a preliminary draft of a report must critically assess the AI output and refine it based on academic sources rather than submitting the text as-is. Misuse of AI for academic dishonesty, such as using it to answer quizzes or bypass critical thinking tasks, constitutes e-cheating and is subject to institutional disciplinary policies (Sullivan et al., 2023). AI literacy must also encompass inclusivity and accessibility, ensuring that all students, including those with disabilities or financial constraints, can equitably engage with AI tools. For example, an instructor using AI-generated materials must verify their compatibility with screen readers to accommodate visually impaired students. Similarly, AI-generated videos should include subtitles to support students with hearing impairments. On the student side, those with special educational needs may request