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AI literacy through the lenses of graduate students: insights from scenario analysis

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Abstract

Generative artificial intelligence tools have gained notoriety since the launch of ChatGPT by OpenAI in November 2022. This technology is based on large language models, simulating a written ‘conversation’ between humans and algorithms, and is capable of generating text from the commands it receives. However, its use in academia is controversial and requires: knowledge of the tools (their strengths and weaknesses); the ability to evaluate sources and content generated by AI; interpersonal collaboration mediated by these systems; understanding the different contexts of use and the parameters for using AI in each context; autonomous and responsible interaction with AI; and consideration of the ethical implications of these tools (Allen & Kendeou, 2024). Considering the growing use of generative AI tools for learning and the complexity of the knowledge involved in their responsible use, the development of these skills – called artificial intelligence literacy – should be prioritised by teachers and students. The objective of this exploratory study was to analyse university students’ understanding of AI use in light of the theoretical framework of AI literacy developed by Allen and Kendeou (2024). The study employed a scenario analysis methodology to explore how graduate students assess the use of genAI in a hypothetical learning situation. Results pointed to difficulty in identifying ethics in the scenario, as shown by low ratings, and overlap with other components of the framework. The justifications unveiled students’ interpretation of ethics as behavioral trace instead of machine-related, as the proposed by the framework. Self-efficacy did not explain variance in scenario rating. These findings provide data on which AI literacy skills students clearly understand and which ones they may need instruction or assistance to develop, such as awareness of AI ethics. We discuss the relevance of theory and in particular the *ED-AI lit* framework to inform AI literacy practices in higher education.

Keywords: generative artificial intelligence, AI literacy, higher education, scenario task.

AI literacy through the lenses of graduate students: insights from scenario analysis

1. Introduction

General artificial intelligence is becoming a common learning resource, extending over diverse purposes such as queries, information checking and text generation. Because these platforms are designed to have a simple interface (e.g., interacting with a chatbot as if you were texting someone), users learn to handle their affordances intuitively and quickly through exploration. Nonetheless, underlying this simplicity is the need for critical reflection about more subtle aspects of genAI such as its underlying mechanisms and ethical limitations. Even more explicit (and better known) aspects, such as evaluating the quality of an output, are part of a set of competencies that individuals alone may not be properly equipped to do. These challenges stimulated research and instruction on new literacies, an interdisciplinary field that gave rise to digital literacy, media literacy, algorithm literacy, AI literacy – and, more recently, genAI literacy (Heung et al., 2026).

Artificial intelligence dates to the invention of computers and the need to tell apart human and machine products through the Turing test, for instance (Epstein et al., 2009). It is a machine-based system that can interpret input data, learn from such input, and use learned information in a flexible manner to perform specific goals and tasks (Haenlein & Kaplan, 2019). This technology is part of our daily lives in online translators, chatbot messages, and recommended content in streaming platforms. Generative AI (henceforth genAI) makes a big leap by performing more complex language tasks in at human level, generating text, pictures, audio or video from the prompts (i.e., written commands) received (Naveed et al., 2024). The technology gained popularity since the release of ChatGPT by OpenAI in November 2022. It draws from large language models (LLMs), which were extensively trained using a massive amount of data, to simulate a conversation between human and algorithm. Although later training stages include reinforcement with human feedback to control for spurious interactions, it is also subject to bias.

GenAI tools have spread to educational contexts, with platforms specifically designed to assist students in a variety of tasks such as summarization, revision, language enhancement, and text generation. Because these tools offer seductive shortcuts to many learning tasks, their use in academic assignments has been regarded as controversial since they reduce cognitive effort (Deng et al., 2024). but also depth of knowledge (Kosmyrna et al., 2025; Melumad & Ho Yun, 2025; Stadler et al., 2024). It puts at stake issues of authorship, originality (Hodges & Kirschner, 2023) and linguistic competence, as well as risks of language homogenization, with the incorporation of words made frequent due to algorithm bias (Kobak et al., 2025) and exposure to false information, made-up data (also known as hallucination), and cultural bias (Kohnke et al., 2023). Using ChatGPT was also linked with decreased citations on a source-based writing task (Tarchi et al., 2024). A meta-meta-analysis of 1,840 effect sizes from 67 meta-analyses showed strong publication bias and between-study heterogeneity, concluding that alleged learning benefits of AI appear premature since they are not yet adequately supported by evidence (Bartoš et al. 2026).

In answering the question *Are LLMs actually good for learning?* Rus and Kendeou (2025) argue that GenAI is good for students given three conditions: if it preserves the effort one needs to learn, if students hold enough prior knowledge in the topic to evaluate the output (which is acquired when they engage in deep information processing), and if they are exposed to LLMs in a progressive manner to prioritize cognitive engagement and self-regulation processes. Bauer and colleagues (2025) suggest that AI may either a) replace traditional instruction; b) provide extra instructional scaffolding to students, or c) create more complex tasks that foster deep learning. There are also risks of inversion, with students outsourcing tasks to AI – which reduces cognitive engagement. According to the author, this problem can be approached through AI literacy and teacher education for technology.

The field of AI literacy discusses how (and whether) genAI should be incorporated in education, including what students need to know about these tools and how they affect learning. AI literacy

frameworks are theoretical constructs that aim to inform instruction, research and policies and promote conscious AI use. Considering the inseparability between theory and practice, the present study departs from the Ed-AI Literacy framework (Allen & Kendeou, 2024). This theoretical framework has relevance given its interdisciplinary nature and possible application across different educational levels – including higher education. Specifically, we employ a scenario analysis method to explore how graduate students assess the use of genAI as described in a hypothetical learning situation that was developed based on the Ed-AI Lit framework. Through this methodology, this study aimed to investigate how graduate students identify and evaluate Ed-AI components when analyzing the use of generative AI in a hypothetical learning situation. This data might unveil learners' understanding of genAI use and whether it reflects core theoretical issues in the field of AI literacy. Considering the predominance of quantitative and theoretical studies on AI literacy in higher education (Černý et al., 2024), the present study contributes to the discussion on AI literacy by providing a qualitative approach to the topic – including university student's views on genAI literacy.

2. Conceptualizing AI literacy

For much time, knowledge in artificial intelligence has been restricted to technical areas in higher education such as computer science and data science (Wong et al., 2025). More recently, AI literacy extended to other areas as well as to basic education (Kong et al., 2023; Lin et al., 2024). Research on AI literacy had exponential growth especially since 2023 – a recent interest that unveils concern with the impacts of this technology on learning (Almatrafi et al., 2024; Yang et al., 2025). AI literacy comprises “a set of competencies that enables students to understand how AI works, critically evaluate them, and use them effectively to communicate and collaborate in various contexts (Allen & Kendeou, 2024, p.4).”

One of the first attempts to conceptualize AI literacy was proposed by Long and Magerko (2020), who described 17 competencies: recognize AI, understand intelligence, identify interdisciplinary AI use, differentiate general and narrow AI, know AI strengths and weaknesses and when to use it, imagine Future AI applications, understand knowledge representations, describe how computers make decisions, awareness of the steps involved in machine learning, recognize the prominent human role in AI, understand basic data literacy, recognize that computers learn from data, describe machine learning, understand the consequences of AI systems in society, knowledge about sensors, ethical issues involving AI (privacy, employment, misinformation, ethical decision-making), and programming.

AI literacy was also framed within Bloom's taxonomy (Ng et al., 2021). Their framework coded four dimensions of progressive complexity: 1) know and understand AI (i.e., related concepts, skills, knowledge and attitudes); 2) use and apply AI in different contexts and applications in everyday life under ethical considerations; 3) critically evaluate and actively engage in creating AI-powered products ; and 4) AI ethics, comprising issues of fairness, accountability, transparency and safety. These constructs are manifested in AI literacy interventions through explicit instruction on how machine learning works, examples of applications, evaluation of output quality, and discussion of issues of fairness, transparency and safety (Almatrafi et al., 2024).

2.1 The ED-AI Lit framework

In response to the new demands posed by the widespread use of LLMs among students, Allen and Kendeou (2024) proposed the *ED_AI Lit*, an Interdisciplinary Framework for AI literacy that proposes overarching principles that can be adapted to different educational levels (table 1). This framework is divided into six components that describe the knowledge and competences that students should develop to use AI effectively: 1) awareness of AI tools and how they work; 2) evaluation of their strengths and weaknesses; 3) collaboration with AI systems; 4) knowledge about uses in real contexts; 5) development of autonomy when interacting with AI systems, and 6) consideration of ethical issues

related to these systems. The authors also suggest possibilities for integrating each realm into instruction across diverse levels of education.

Table 1 – Summary of the ED-AI Lit framework (Allen & Kendeou, 2024)

Component	Description	Integration to instruction
Knowledge	It comprises awareness of AI technologies and how they work (i.e., underlying principles, algorithms, and applications) and also encourages the incorporation of AI in other domains for an interdisciplinary view of its applications.	Explanation of underlying principles of machine learning and how AI technologies operate. Discussions about real-world applications and multidisciplinary uses of AI.
Evaluation	It involves the ability to critically analyse AI-generated products considering their strengths, limitations, and potential biases. It extends to the evaluation of online information sources, considering that content available on the internet might lack credibility.	Fostering evaluative skills to assess AI technologies and the credibility of information sources.
Collaboration	It comprises both interaction with AI systems and interpersonal collaboration skills. It highlights the need to develop skills for collective work mediated by AI systems, effective communication and interaction with AI systems and individuals. Understanding of human-machine interaction.	Promote student exploration of chatbot interactions and prompting; group work mediated by collaborative AI systems; group discussions on the ethical implications of AI.
Contextualization	This component stresses the importance of understanding the diverse uses of AI in real-world contexts and their implications. It fosters awareness of the role of AI in different learning contexts such as everyday or academic scenarios with emphasis on how AI operates across domains.	Create opportunities for the application of AI technologies (e.g. case studies, scenarios) in different scenarios and domains.
Autonomy	It gives prominence to independent and responsible interaction with AI systems. It encourages students' self-determination and responsibility for their learning process, and supports informed decision-making when exploring the potential of AI tools	Support student control over their learning and informed decision making. Encourage free investigation of AI tools and discussion on the approaches how AI was used.
Ethics	It emphasizes the need to understand and consider the ethical implications of AI technologies and their use. Such implications include algorithm biases (which might perpetuate prejudices, discrimination, and social disparities), issues of transparency and accountability in AI systems.	Emphasis on the ethical considerations that need to be accounted for in employing AI technologies. Discussion of real-world dilemmas.

The higher education context calls for specific AI skills. The framework proposed by Wong and colleagues (2025) comprises four skills: AI ethics (e.g. data privacy, algorithmic bias), computational thinking, collaboration with AI, and uniquely human abilities like creativity and critical thinking. Universities should thus focus on the development of human capacities over technical knowledge. There are some points of convergence among the AI literacy theories reviewed above (table 2). All frameworks mention the need for some understanding of how AI works as well as ethical issues involved in its use. Three of them point out the need to evaluate AI products and understand their use in different contexts.

Table 2 – equivalencies between AI literacy frameworks

Long & Magerko (2020)	Ng et al. (2021)	Allen & Kendeou (2024)	Wong et al. (2025)
Describe computer decision-making; understand machine learning and data literacy	Know and understand AI	Knowledge	AI literacy
Ethical issues	AI ethics	AI Ethics	AI ethics
Identify AI strengths and weaknesses	Critically evaluate and actively engage in creating AI-powered products	Evaluation	-
Imagine future AI applications	Use and apply AI in different contexts	Contextualization	-
-	-	Collaboration	Human–AI collaboration
-	-	Autonomy	Human distinctive capacities

3. AI literacy in higher education

Across levels, students' AI literacy has been assessed through subjective self-reported measures such as surveys, and objective measures such as testing (Almatrafi et al., 2024). Profiling studies have developed instruments such questionnaires to trace self-reported behavior and tests to measure knowledge about AI (see Lintner 2024 for a review across populations). The MAIILS – Meta AI literacy scale – was developed to identify students' uses of AI tools and awareness of AI literacy (Carolus et al.

2023) and validated in eastern Europe (Markova & Yordanova, 2025). In particular, university students' conceptualization of AI literacy was approached through a questionnaire (Černý et al 2024). Students' responses emphasized ethical principles as a distinctive facet of AI literacy in a society that is deeply changing. Shifting away from self-assessment, knowledge about AI was measured in a multiple-choice test, revealing that undergraduate students in Germany, the UK, and the US have a reasonably good AI literacy level (Hornberger et al., 2023; 2025). Taken together, these studies underscore the need to develop effective AI instruction considering that student's prior knowledge in AI literacy may vary.

Intervention studies sought to develop AI literacy through instructional programs. A scoping review with 30 studies identified a few major themes approached by AI literacy programs in higher education: principles of machine learning, how AI works, its possibilities and limitations, and ethical issues related to algorithm bias and transparency (Laupichler et al., 2022).

The promotion of AI literacy also involves awareness of the institutional policies that regulate AI use. Analysis of guidelines from eleven Asian universities revealed that some institutions restrict the use of genAI tools among students, while others emphasize instruction on aspects related to AI knowledge, autonomy, ethics, and contexts of use (Wong et al., 2025). However, universities often lack the guidelines to regulate the use of genAI among its students and faculty members. These institutional policies have the potential to mitigate disparities among countries, universities, and students.

3.1. Case-based learning as a means to assess AI literacy

The present study employs a case-based learning methodology to trace students' knowledge of genAI and their ability to identify good and bad practices. The scenario developed portrays a hypothetical academic assignment in which a student describes how they approached tasks using generative AI – which was allowed by the professor under restricted conditions. The premise is that reading and analysis of the scenario may unveil self-regulated learning processes. Specifically, the actions described may trigger the students' self-reflections through a judgmental subfunction, with

evaluation based on the individual's personal standards (Bandura, 1986). Although endorsing certain standards of behavior does not ensure their incorporation in one's attitudes, analysing a scenario might play this metacognitive role. In addition, the scenario also offers a detailed narration that provides students with data to evaluate student behavior under the theoretical perspective proposed and hence construct a critical understanding about what optimal use of genAI looks like.

Case-based learning has been used as a pedagogical tool to enhance critical thinking and problem-solving skills. It offers a more concrete perspective of abstract concepts such as ethics and autonomy in a real-life like context, which facilitates instruction on AI literacy (Allen & Kendeou, 2024). A few AI literacy programmes included case-based learning, with emphasis on the development of ethical awareness (Heung et al., 2026 for a review). These scenarios comprised analysis of dilemmas found in real-world AI applications (Lin, Wang, et al., 2023), and topics like autonomous vehicles and pedestrian safety and the misuse of personal data (Usher & Barak, 2024). Practical problems with GenAI were also included in an intervention (Relmasira et al., 2023) The tests used to check the effectiveness of an intervention aimed to promote AI literacy were also embedded in real-life contexts (Kong et al., 2023). Educational games also used case-based discussions in role-playing gamers to promote AI literacy (Ng, Xinyu, et al., 2024).

4. The present study

This study aims to investigate university students' understanding of genAI literacy in light of the theoretical framework developed by Allen and Kendeou (2024). Previous research on AI literacy has been mostly grounded in the computer STEM areas, resulting in greater focus on technical aspects such as knowledge about artificial intelligence, i.e., its underlying mechanisms, functions, and ethical problems. The ED-AI lit framework adds to the field by focusing on the interaction between genAI and learning at diverse educational levels. It draws from well-established concepts of AI literacy such as

knowledge about AI and AI ethics (Long & Magerko, 2020; Ng et al., 2021; Laupichler et al., 2022), extending its scope to context and human-related factors overlooked by previous literature that are crucial to learning such as evaluation, collaboration, and autonomy.

The study employs a case-based learning methodology: a scenario was developed that illustrates the ED-AI literacy components. The goal was to check whether university students identified these components and assess how they were portrayed (i.e., as good or poor examples generative AI use), justifying their stance. These data may reveal whether learners' knowledge of genAI literacy aligns with relevant theoretical discussions on AI literacy – which in turn can inform future interventions in higher education.

Objectives and research questions

To reach this goal, three research questions were posed:

1. Are the Ed-AI lit framework components (knowledge, evaluation, collaboration, contextualization, autonomy and ethics) perceived as discrete items in the rating of a hypothetical scenario of genAI use?
2. Do justifications reflect a framework-based analysis of the scenario?
3. Does self-efficacy predict performance in the scenario task?

To answer RQ1, students were asked to rate how each component of the ED-AI lit framework was represented in a hypothetical learning scenario. RQ2 consisted of a qualitative analysis of students' written justifications to the rating based on the ED-AI lit framework. RQ3 was approached by testing the predictive effect of the self-efficacy measure on scenario analysis.

5. Method

5.1 Design and participants

This qualitative exploratory study employed convenience sampling. Participants were 44 students (10 male, 1 non-binary; mean age = 23.45; $SD = 2.42$) enrolled in the master's degree in educational psychology at an Italian university during the semester of data collection. The project was approved by the ethics committee (protocol n° 005487 decision n° 463). Participants reported frequency of use of genAI tools in three different settings: at work, university and daily life. Responses were reported on a 5-point Likert scale, with higher frequency of use in academic assignments (work = 1.84, $SD = 1.2$; university = 3.45, $SD = 0.87$; *daily life* = 2.90, $SD = 0.96$).

5.2 Materials and measures

The materials developed for this study and the instruments used to measure performance are available at <https://doi.org/10.5281/zenodo.19652652>.

5.2.1 Self-efficacy measure

Self-efficacy refers to the confidence students report of their own capacity to perform particular tasks in certain contexts (Bandura, 1986). Among secondary students, computational thinking efficacy in learning AI was positively related to AI literacy (Lin, Zhou et al., 2024). The self-efficacy measure developed for the present study aimed to trace students' self-perceived capabilities related to AI use based on the *ED-AI lit* framework. Each of the six items accounted for a specific *ED-AI lit* component (e.g.: *I know how AI tools work i.e., their principles, algorithms, and applications; I can evaluate the strengths and limitations of AI technologies and the quality of their products; I can interact with AI systems and use them to collaborate with peers*).

5.2.2 Scenario task

Drawing from the principles of case-based learning, the scenario task constructed for this study described a hypothetical case of genAI use at university that illustrated the components of the *ED-AI lit*

framework (Allen & Kendeou, 2024). The task comprised instructions, a description of the assignment (a group presentation about learning theories), and the student testimony reflecting about his use of genAI in different stages of the assignment. The text material was 553 words long (including instructions) and was presented in Italian. The assumption is that providing participants with the scenario of an academic task similar to what they are usually assigned would trigger deeper behavioral analysis compared to self-reports. The task was presented on a Google form that could be accessed from participants' own devices either via link or QR code.

After reading, participants were asked to rate how each AI literacy component was considered by the student in the assignment (e.g.: *How do you rate the student's KNOWLEDGE about AI tools? How do you rate the student's EVALUATION of AI products and sources?*). Ratings were done on a 5-point Likert scale ranging from "very poor" to "very good". After, they provided a written justification to their rating based on the scenario just read. For data analysis, answers to the Likert scales for the measures of evaluation and autonomy were reverse coded because these components were depicted as negative (i.e., non competent) behavior in the scenario. Justifications to the ratings underwent thematic analysis to discern patterns of argumentation based on each of the ED-AI lit framework components and also accounting for other patterns that arose during qualitative analysis.

5.3 Procedure

Data collection took place during class time in November 2025. First, students were introduced to fundamental concepts in artificial intelligence and the *ED-AI lit* framework for AI literacy. Because this moment was similar to a lecture on the topic, they could interact with the researchers and ask questions. The slide material comprised a contextualization with definitions of artificial intelligence and how it distinguishes from generative AI, including examples of different types of large language models (LLMs). Next, the concept of AI literacy was presented and students were introduced to the *ED-AI lit*

framework. Each component was described and illustrated with examples. The last slide provided a summary of the six components.

After instruction, students were directed to the scenario task. The researchers made clear that, upon their consent, the data collected through the form would be analysed in a study on AI literacy in higher education. Information about the study was also provided in the first section, i.e., the consent form. All students agreed to participate. The form could be accessed either via QR code or link found in the course digital environment. After consent, students answered demographics questions (name, age and education level), a survey about frequency of AI use, the self-efficacy measure, and the scenario task.

Instruction for the scenario task was as follows: “Now you are going to analyse a learning scenario that describes a course assignment followed by the testimony of one student describing how she approached the task. Your job is twofold: a) to rate how successfully each component was developed, and b) to select excerpts of the scenarios as examples of each AI literacy component. Please read and analyse the scenario carefully. Remember that each component might be either a good or a poor example of performance.” After reading the scenario, participants rated the behavior described according to each framework component and provided a written justification for the rating. Total task time was set to 15 minutes.

6. Results

6.1 Are the Ed-AI literacy model components perceived as discrete items in the rating of a hypothetical scenario of genAI use?

Answers to the Likert scales for the measures of Evaluation and Autonomy were reverse coded because the scenarios depicted negative models. Therefore, high scores in all components were interpreted as rubric-congruent rating. Two students did not provide justifications to their Likert ratings

(n=42). Descriptive data shows high scores in the scenario rating, indicating that participants successfully assessed the Ed-AI lit framework in the scenario given (descriptives table). However, participants failed to identify the ethics component ($M = 2.09$, $SD = 0.85$), which resulted in inaccurate rating. In the scenario, ethics is approached as the student highlights a positive feature of the LLM: the possibility of working only with uploaded documents since “having control over the database enhances transparency and decreases the risk of bias”. This was coded in the rubric as a positive example of ethics. However, participants approached ethics as a behavioral trait, which resulted in rating this component as poor.

We also ran multiple pairwise correlations between rating scores for each of the six framework components represented in the scenario. One significant correlation was found between autonomy and ethics, which evidences some overlap between these two components ($\rho = -0.45$, $p = .002$). Therefore, in answer to RQ1, participants were able to interpret the scenario based on theoretical assumptions from an AI literacy framework, which provides evidence for its validity, although there was some overlap between the components autonomy and ethics.

6.2 Do justifications reflect a coherent framework-based analysis of the scenario?

Thematic analysis indicated that participants’ justifications were in accordance with the *ED-AI lit* framework, although there was some overlap between components. For instance, in answering the question *How do you rate the student’s knowledge about AI tools?*, participants provided justifications based on evaluation (n=9). Similar overlaps were found between evaluation and autonomy (n=9) and contextualization and autonomy (n=10), with participants criticizing the student’s outsourcing of task parts to genAI such as summarising. We also identified instances of justifications based on personal view i.e., written in first person singular and related to one’s thoughts and perceptions on AI use – which were unrelated to the framework. In relation to the ethics component, eleven participants did not provide a structured justification to their rating. Two types of ethics-based justifications were found:

justification based on ethical behavior i.e., responsible use of genAI (n=8) and justification based on ethical dilemmas related to the technology (n=5).

6.3 Does self-efficacy predict performance in the scenario task?

Also drawing from the *Ed-Ai lit* framework, we constructed six questions to assess participants' self-efficacy in relation to generative AI use. We hypothesized a positive correlation between the self-efficacy measure and high scenario ratings. To check this assumption, a linear regression model was fit with scenario mean scores as response and self-efficacy as predictor. However, self-efficacy did not explain variance in scenario scores ($F(1, 42) = 1.67$, $p = 0.20$, $R^2 = 0.038$). Adding frequency of use at university as covariate did not significantly enhance model strength.

7. Discussion

The present study sought to investigate how graduate students perceive the use of genAI for academic assignments through the lenses of the *ED-AI lit* (Allen & Kendeou, 2024), a theoretical framework of AI literacy. Em employed a case-based learning methodology in which participants analysed a scenario describing an academic assignment by providing justified ratings. Taken together, the results endorse the relevance of the *ED-AI lit* framework to inform AI literacy in the higher education context, shedding light on how graduate students understand AI literacy through these theoretical lenses, how its components interact, and which aspects need to be further developed. The fact that the framework components overlapped in the justifications provided to the ratings can be interpreted as indicative of its internal consistency, since participants tried to connect related components of the framework (not to prior knowledge, for instance).

7.1 Ethics as social responsibility

Participants successfully rated most of the framework components, except for ethics. The correlation found between the ratings of autonomy and ethics indicate that students perceive these

components as closely related. In the justifications, ethics was perceived more as a behavioral trait than as machine-related. These data converge in showing that graduate students endorse an interpretation of ethics as an individual decision-making process. Nevertheless, four relevant frameworks of AI literacy (reviewed in table 2) endorse instruction on AI ethics as a major component (Long & Magerko, 2020; Ng et al., 2021; Allen & Kendeou, 2024; Wong et al., 2025). The Ed-Ai literacy framework stresses that ethical dilemmas are inherent to any use of genAI. Even if all individuals make ethical applications of these tools, the risks will remain. These risks pertain to the negative outcomes of genAI operation such as the consumption of energy and natural resources for data center maintenance, as well as issues of transparency, fairness, safety, data privacy and accountability (Allen and Kendeou, 2024). A scoping review approaching AI ethics warns that, with the rise of genAI, new ethical and safety issues emerged such as jailbreaking (designed to bypass safety mechanisms), hallucination, alignment with human values (training AI for to be harmless, helpful, and honest), harmful content, copyright, leaking private data, and impacts on human creativity (Hagendorf, 2024).

Because the ethical issues related to how the technology operates are not apparent, they are difficult for users to identify. Therefore, promoting AI ethics involves knowledge about how genAI tools function (Celik, 2023) as well as the social, environmental and political consequences of their operation.

Nevertheless, looking at ethics in genAI use as an individual concern reduces the real dimension of the problem and transfers its responsibility from the big techs to individual users. It is therefore crucial that educators draw students' attention to the implications of genAI and their role as citizens in demanding a more democratic and transparent relation with these products.

In their justifications, participants seemed more concerned with academic integrity than with the ethical limitations of GenAI tools. This is in line with previous works that associate GenAI ethics to academic integrity (Weigelt et al., 2026). In the the ED-AI lit framework, responsible interaction with AI systems is situated within the autonomy component. Autonomy intertwined with other components,

overlapping with evaluation, contextualization and ethics in the justifications. Indeed, autonomous interaction with AI systems is an essential component of AI literacy. In this line, Wong (2025) highlights the need to focus on the development of human capacities over technical knowledge. It requires students' self-determination and considerations about what an honest use of genAI tools looks like and also involves queries such as when AI use is welcome and how to preserve student effort when learning with genAI systems (Rus; Kendeou, 2025).

7.2 Self-efficacy and task performance

We expected that self-efficacy would have a positive association with scores in the scenario task; however, this assumption was not confirmed. Although the literature indicates self-efficacy as a predictor of task performance, with computational thinking efficacy as positively related to AI literacy (Lin, Zhou et al., 2024), a systematic review investigating the effect of ChatGPT on learning showed no significant effects of genAI use on self-efficacy (Deng et al., 2025). However, the studies reviewed investigated self-efficacy as a response variable.

Other variables might have interfered with the usual predictive power of self-efficacy such as context and type of task (Bandura, 1986). In this new learning scenario, students may not yet understand how familiarity with these tools affects their ability to understand, evaluate and use genAI – therefore self-efficacy is compromised. More studies are needed to fully grasp the interaction between self-efficacy, genAI literacy, and perceived learning outcomes when interacting with genAI tools.

Conclusion

The present study sought to explore how theoretical accounts of AI literacy such as the *ED-AI lit framework* intertwine with graduate students' understanding about AI, including issues of source and output evaluation, collaboration, principled use, and AI ethics. The results revealed that the framework provides a consistent theoretical orientation for the development of AI literacy practices. One limitation

regards the lack of randomization in the items comprising the scenario analysis task, with students providing justifications for the last or next-to-last answers experiencing some fatigue. Regarding the pedagogical implications, our methodology allowed the identification of gaps in students' knowledge that deserve closer attention in future GenAI literacy interventions, such as emphasis on the ethical issues of AI tools and the responsibility big techs have in providing safe products. In addition, the scenario constructed for this study is available as an open educational resource and might be used by educators to trace student profile and trigger discussions about the technological and behavioral issues involved in the use of genAI in academic assignments. Taken together, our findings highlight the need for AI literacy that is concerned not only with teaching technical aspects of AI but also – and crucially – with developing awareness of its ethical implications for learning, since the preservation of students' effort and the construction of prior knowledge should be the primary goal of instruction (Rus & Kendeou, 2025).

Authors contributions (*contribuição de autoria*)

Juliana do Amaral: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, writing – original draft preparation, review and editing. **Marília Camponogara Torres Fontoura:** conceptualization, methodology, writing – review and editing. **Christian Tarchi:** conceptualization, formal analysis, investigation, methodology, project administration, supervision, writing – review and editing.

Conflicts of interest (*conflito de interesses*)

We have no conflicts of interest to disclose.

Ethics committee approval (*declaração de aprovação do Comitê de Ética*)

The project was approved by the ethics committee of University of Florence (protocol nº 005487 decision nº 463).

Data availability statement (*declaração de disponibilidade de dados de pesquisa*)

Materials and data are openly available at <https://doi.org/10.5281/zenodo.19652652>.

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