

Teachers Interacting with Generative Artificial Intelligence: A Dual Responsibility

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Abstract

This paper explores the integration of Generative Artificial Intelligence (GAI) in education, focusing on the pivotal role of teachers. It introduces current policies from educational organizations and governmental institutions, and briefly reports on research evidence on the topic, emphasizing the need for targeted training programs. These programs are essential for equipping educators with proactive strategies to harness this emerging technology, not only to enhance professional practice but also to effectively guide students in developing AI literacy, utilizing both hidden and explicit curricula.

Keywords

education, GAI systems, teacher training.

1. Introduction

The educational landscape is currently undergoing a significant transformation, driven by rapid advancements in technology. The advent of ChatGPT and other Generative Artificial Intelligence (GAI) systems marked the beginning of a period characterized by increasing interest in Artificial Intelligence (AI).

Educational organizations and governmental institutions, as well as academic communities, have actively responded to this emerging technology, continuing a trajectory that began years earlier with tutoring systems [1], personalized learning [2], and the collection and analysis of learning data [3]. European projects commissioned and coordinated by the European Union are producing resources, guidelines, and reports [4]. UNESCO issued several

policy documents [5] and is currently developing a new AI competency framework for teachers and school students [6]. Within the academic context, there are significant investments concerning the drafting of regulations and directives, the launch of experimental studies [7], and the creation of themed laboratories.

The educational sector is generally characterized by its slow pace. It takes time to observe the outcomes of implemented strategies. However, it is currently a critical area for reflection and the deployment of AI and GAI technologies, facing the challenge of engaging with a subject that evolves even as it is being discussed [8].

This paper examines proposals for teacher training, considering input from educational organizations and governmental institutions at global

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European, and Italian levels, as well as evidence from scientific research. The aim is to stimulate reflection on the dual importance of such training, which is relevant not only for enhancing professional practice but also for guiding students in developing AI literacy.

2. Generative Artificial Intelligence in Education

GAI is a specific type of AI within the area of Machine Learning (ML). It aims at creating new content such as texts, images, videos, music, and 3D models, based on the data learned from during a training phase. GAI uses several key technologies, including Generative Adversarial Networks (GANs), Recurrent Neural Networks (RNNs), and transformers like the Generative Pre-trained Transformer (GPT) models.

The interaction process with GAI systems, especially with Large Language Models (LLMs), is mostly conversational. Dialogue exemplifies a shared domain of knowledge where the human partner progressively “reads” the algorithmic knowledge of the machine through his/her own internal knowledge [9].

GAI systems promise to enhance the teaching and learning experience [10]. Taking research in higher education as an example, these systems are used by teachers to reduce their workload, refine instructional methods, and evaluate student performance [11]. They can also help in creating educational resources, such as lesson plans or worksheets, and in developing assessment tools like quizzes and feedback mechanisms [12]. On the other hand, students benefit from AI systems as personal tutors, helping them grasp difficult concepts, prepare for exams, and improve their skills [13]. Moreover, scholars recognize the potential of GAI to provide equal learning opportunities, meeting the diverse needs of all students, especially those with specific educational needs [14].

Concerns about the use of GAI systems in educational settings primarily stem from this technology’s tendency to generate content that may be inaccurate, misleading, completely erroneous (*hallucinations*), or that can perpetuate societal biases, such as stereotypes or discriminatory viewpoints [15; 16]. These issues stem partly from the intrinsic probabilistic nature of machine learning technologies and partly from the potentially incorrect or outdated data on which these systems are trained.

To effectively utilize GAI systems, it is essential that the human partner demonstrates competence regarding the content of the conversation and can

evaluate the quality and relevance of the system’s output. From this perspective, GAI systems can be viewed as *process partners* rather than *content partners*, assisting teachers in instructional practices and students in their own learning. In the latter case, it might be more appropriate that GAI systems support methodological and metacognitive aspects of learning rather than the exploration of a specific disciplinary content.

GAI systems serve as evocative objects of individual knowledge too, as they necessitate ongoing reflection during the formulation of prompts and analysis of outputs, encouraging a deep consideration of what is known and what remains unknown [9].

3. Education in the Italian AI Strategy for 2024-2026

Italy is aligning with the European approach to AI through a new AI Strategy. In April 2024, the Department for Digital Transformation and the Agency for Digital Italy released an executive summary regarding the period 2024-2026 [17]. The previous strategy covered the period 2022-2024 [18]. The summary encompasses four main areas: *scientific research, public administration, business, and education*.

AI appears to have transformative potential in Italy’s socio-economic landscape. However, to capitalize on its benefits, high-level professional skills for developing and managing AI algorithms and systems are essential.

As a result, the educational strategy is primarily aimed at enhancing training on AI, including GAI, across educational institutions, from technical institutes to universities, with a particular emphasis on PhD programs. It also includes significant investments in reskilling and upskilling programs for the workforce, ensuring that no worker is left behind in this dynamic environment. These initiatives aim to make workers competent in using new technologies and to integrate AI more broadly across society to mitigate long-term social and economic disparities.

Moreover, the educational strategy suggests the introduction of AI literacy pathways in schools that include ethical and social issues is essential, along with the establishment of internships, exchange programs, and visiting opportunities in companies and research institutions.

The summary does not explicitly mention teacher training. However, by addressing the issue of AI literacy in schools, it implies that such education should be imparted to students by their teachers or by external experts.

Conversely, a commitment to teacher training is highlighted in the “Futura - Education for the Italian Future” action plan within the 2021 National Recovery and Resilience Plan (NRRP), which is part of the NextGenerationEU (NGEU) programme [19]. “Futura” seeks to “create a new educational system that guarantees the right to education, digital competencies, and the necessary skills to face future challenges, thereby overcoming all forms of inequality and countering early school leaving, educational poverty, and regional disparities” [20]. In this context, numerous educational hubs distributed across Italy offer initiatives for teachers aimed at exploring the potential of integrating AI and GAI in teaching and learning. Some “Futura” courses and workshops are based on the outcomes of “AI4T - Artificial Intelligence for and by Teachers”, a European pilot project in teacher training on AI funded by Erasmus+ and promoted by the European Commission as part of the European Digital Education Action Plan 2021-2027 [21].

4. Teacher Training on GAI

Teachers play a dual role with respect to GAI systems, acting both as *direct* users within their professional practice and as *facilitators* in guiding students in their relationship with technology. These roles are also related to the nature of the educational event, which includes an *explicit curriculum*, involving the formally taught content, and a *hidden curriculum*, involving the implicit lessons learned by students as they interact with the teacher [22]. Regarding the hidden curriculum, the integration of technology in the classroom by the teacher, as well as his/her attitude and perspective, ranging from frustration and skepticism to enthusiasm, may influence students’ perceptions. A teacher who uses GAI systems in a proactive and visible manner and who critically and curiously embraces new tools can encourage students to develop a positive attitude towards technology and, more broadly, towards innovation [23]. This impact is further reinforced if, within the explicit curriculum, the teacher not only imparts knowledge and skills but also provides opportunities for discussion and constructive reflection.

Considering the policies of European and international institutions, the issue of teacher training on GAI is currently encompassed within the broader topic of AI, except for a few specific documents that mostly propose good practices and case studies.

Below, we briefly analyze the proposals from European bodies, the United Nations, and Italy, before

moving on to some references drawn from the scientific literature.

The European Digital Education Hub (EDEH)’s Squad on Artificial Intelligence in Education, primarily focused on primary and secondary schools, has identified three segments of teacher use of AI [24, 25, 26], effectively integrating the two dimensions mentioned above:

- Teaching *for* AI, i.e., acquiring and promoting a critical view, focusing on ethics and sustainability, and evaluating the opportunities, benefits, limitations, and risks (e.g., biases, inaccuracies) of using AI in society.
- Teaching *about* AI, i.e., imparting technical-computer science notions regarding AI’s technology (e.g., Machine Learning and Natural Language Processing).
- Teaching *with* AI, i.e., employing AI systems to achieve teaching and learning goals.

In the absence of an update to the Digital Competence Framework for Educators, known as DigCompEdu [27], the Squad used existing European documentation to identify what teachers should know, understand, be able to do and what attitudes could support them in correctly interacting with GAI systems [25].

For the Teaching *for* AI segment, the Squad employed the dimensions and examples of knowledge, skills, and attitudes from the last update of the European Commission’s *Digital Competence Framework for Citizens*, known as DigComp 2.2 [28]. For the Teaching *about* AI segment, the EDEH identified several competency areas based directly on students’ needs: basic digital skills, existing AI applications, computational thinking, mathematics, and specific AI topics. For the Teaching *with* AI segment, the Squad revisited and reorganized the indicators from the European Commission’s *Ethical guidelines on the use of artificial intelligence (AI) and data in teaching and learning for educators* [29], aligning them with the six areas outlined in the above-mentioned DigCompEdu.

Regarding teacher training within the European context, it is also worth mentioning the report on “Professional Development for Teachers in the Age of AI” from the European Schoolnet Academy [30]. Without claiming to offer a framework, the report serves as a guide for educators and policymakers on how to effectively prepare teachers for a future where AI plays a significant role in education. It emphasizes the importance of ethical considerations, continuous

learning, and practical application of AI tools in teaching, also offering examples on the topic of GAI.

Going beyond Europe, as part of the “AI and the Futures of Learning” initiative, UNESCO is currently developing two new competency frameworks for AI, including GAI, aimed respectively at teachers and schools’ students. This framework is scheduled to be published in September 2024 and will likely guide future AI literacy in the educational sector. The draft released in April 2024 outlines five aspects — *human-centered mindset*, *ethics of AI*, *foundations and applications of AI*, *AI pedagogy*, and *AI for professional development* — and is structured around three progression levels — *acquire*, *deepen*, and *create* [6].

In Italy, there are no specific guidelines regarding teacher training on the topic of AI and GAI, which could be included in the new initial training for secondary school teachers established by the Decree of the President of the Council of Ministers dated August 4, 2023 [31].

Scientific literature offers contributions specifically focused on the topic of GAI and evidence that can be classified with respect to different educational levels. It agrees on the importance for teachers to receive adequate training to develop effective navigation skills to maximize the benefits of GAI systems and to ensure their ethical and effective use by students [32; 33; 34]. Some scholars highlight the significance of teachers’ pedagogical expertise in utilizing these systems, asserting that the quality of the output hinges on the teacher’s ability to formulate quality questions [12; 35; 36]. In the educational context, a prompt appears effective — i. e., *pedagogical* — if it includes variables related to a pedagogical intention, clearly refers to a disciplinary content (the subject of the topic), and is part of an approach where technology is considered a partner in the teaching-learning process. Therefore, forging an active partnership with GAI systems seems to require not so much digital training as rather a comprehensive teacher training, in line with established frameworks like the Technological Pedagogical Content Knowledge (TPACK) [9; 37].

TPACK focuses on the intricate interplay between technology, pedagogy, and subject matter, empowering teachers to devise teaching strategies that are both effective and suitable for specific educational settings. With the introduction of GAI, one of the authors of the TPACK framework, along with some colleagues, has started a conversation about the continued applicability and value of this proposal. The research group suggests that teachers must inevitably give central importance to a fourth aspect, the *context*, i.e. must be aware of the wider systemic influences

that may enable or limit the use of GAI systems, such as state policies or educational standards [38]. This means that teachers need to understand not only the function of GAI and its implications for teaching and learning, but also its role in shaping a new ecosystem and, thus, its transformative effect on individuals and society [9].

5. Conclusions

The discussion above clearly shows that the field of teacher training on GAI is receiving considerable focus from educational organizations, governmental institutions, and research community. In the former case, the focus is more shifted towards primary and secondary education and falls within the broader context of AI literacy, while in the latter, the considerations prove to be more specific and targeted towards the different levels of education.

Authors highlight the critical importance of investing in fostering a proactive and critical approach towards GAI: teachers need to not only grasp how GAI works and supports teaching and learning, but they also need to consider their pivotal role as educators, guiding students within a changing social ecosystem. This *dual responsibility* clearly represents a challenge: teachers need to train *to use* and *disseminate* a technology that evolves as it is discussed.

In this regard, following a systematic review of the literature produced up to 2023, the research group authoring this paper is working on some task-based experiments to obtain validated good practices. The goal is to produce evidence-based guidelines for teacher training on GAI, thereby supporting the educational community in critically interacting with this emerging technology.

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