From Artificial Intelligence to Artificial Assistants in Education: Theoretical Foundations and First Applications in Teacher Education

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Abstract
The article explores the potential and limitations of Generative Artificial Intelligence (GenAI) in teacher training and inclusive education, emphasizing the importance of specific training for educators on the pedagogical use of these technologies. Experiments conducted at the University of Turin highlight the role of GenAI in creating personalized teaching materials and supporting student learning, particularly for those with Special Educational Needs (SEN). However, it is clearly evident that careful teacher supervision is essential to ensure pedagogical validity and alignment with educational objectives. The article concludes that GenAI should be considered a teaching assistant, integrated into a critical, human-centered approach aimed at fostering inclusive and student-centered learning.

Keywords: Artificial Intelligence in Education; Inclusive Education; Teacher Training; Personalised Learning; Learning Technologies

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1. Strong AI and Weak AI: processes versus outcomes

The release of the first free version of ChatGPT on 30 November 2022 and the subsequent widespread use of Generative Artificial Intelligence (GenAI) is triggering a social change, the effects of which are visible in various areas of social and individual life. The term “Artificial Intelligence” (AI) generally refers to a field of computer science that develops tools to solve problems that would normally require human intelligence (Russell and Norvig, 2010).

However, technological progress has not yet produced AI devices whose potential in terms of complexity and plasticity is comparable to that of the human mind (Artificial General Intelligence – AGI – or “Strong AI”; Searle, 1990). Nevertheless, the use of so-called “Weak AI”, i.e. the development of devices that mimic the results of human behaviour when performing certain tasks, has very significant implications for individuals, organisations, and society in general (Amershi, 2020). Certain activities performed by Weak AI systems, such as visual perception, speech recognition, decision-making processes and linguistic translation, lead to outcomes comparable to those that reasoning developed by the human mind could lead to (Brauner *et al.*, 2023): not only do they correctly perform mechanical and repetitive operations, such as alphabetising a set of terms, they successfully translate a text according to the input language, they can effectively implement an action, such as unlocking or not unlocking a door based on facial or speech recognition data.

Nevertheless, the similarity of the results obtained does not go hand in hand with the similarity of the mechanisms (Cristianini, 2023): in fact, Weak AI devices are based on the processing of big data driven by statistical-probabilistic models (Watanabe, 2023), a mechanism that is not reflected in the description of intelligence described by the recent psycho-educational tradition (Gardner, 1983; Sternberg, 1988; Goleman, 1996). Indeed, a fundamental element of AI is machine learning (ML): a statistical-probabilistic approach that allows machines to be trained to solve specific problems based on available data and accumulated experience in the form of feedback from users (Robilia and Robilia, 2020).

2. AI in education: a growing interest

Interest in AI in education (AIED) is steadily increasing. Recently published UNESCO documents (2019; 2021a; 2021b) emphasise the potential of AI to contribute to the achievement of Goal 4 of the 2030 Agenda, which aims to ensure inclusive, equitable and quality education by promoting learning opportunities for all. In March 2024, the European Parliament finally adopted the Artificial Intelligence Act (European Parliament, 2023), emphasising the importance of regulating the use of AI to mitigate the risk of new educational inequalities (Flores-Vivar and García-Peñalvo, 2023) and to ensure that its benefits are accessible and equitably distributed to all.

However, one of the main obstacles to the deliberate introduction of AIED is teachers' limited knowledge of AI devices. Indeed, most educators lack the necessary skills to consciously and pedagogically use AI in their teaching practise, and specific training, especially during initial teacher training, is still scarce (Hrastinski *et al.*, 2019). Recent studies emphasise that teachers' training time is critical to their attitude towards AIED, a crucial factor in ensuring their educational effectiveness once they are inducted into the profession (Yang and Chen, 2023).

Since 2017, the academic literature on AIED has increased significantly (Xia *et al.*, 2023). In addition, the response to the Covid-19 pandemic emergency has further accelerated the transition to technology-enhanced education (EdTech). The availability of advanced AI systems capable of matching or surpassing human performance in areas such as synthesis, self-correction and big data management has raised relevant questions about the integration of AI into education (Ullrich *et al.*, 2022).

Systematic literature reviews have identified some key elements to assess the impact of AIED. Xia *et al.* (2023) have identified 13 main functions of AI spread across four areas: Learning, Teaching, Assessment and Administration. In addition, they identified seven learning outcomes that affect both students (motivation, engagement, academic performance, 21st century skills, non-cognitive aspects) and teachers (work efficiency, teaching competence, attitude towards AIED). Experimental research shows that the use of virtual assistants in educational environments can support students to close gaps in their self-regulation skills by providing personalised support (Pogorskiy and Beckmann, 2023). Furthermore, the integration of AI into learning management systems (LMS) enables the provision of real-time adaptive feedback that enhances autonomous learning strategies, as well as the graphical representation of students' learning progress, e.g. via radar charts, to promote motivation for self-learning, a key element of Lifelong Learning (Chih-Yuan Sun *et al.*, 2023).

3. GenAI and customised teaching

Zawacki-Richter *et al.* (2019) have highlighted how the introduction of AI in EdTech has taken place in a context historically dominated by an engineering approach aimed at developing predictive models and often lacking a psycho-pedagogical theoretical analysis. From a psychological perspective, recent research shows that the acceptance of the use of AI by students is strongly influenced by three key factors: Performance Expectations, Habit, and Hedonistic Motivation. It has been shown that these factors correlate positively with the intention to use AI: students develop familiarity with the technology through repeated use (habit), adopt it when they feel it helps improve their learning (expectations), and increase adoption as a function of enjoyment and interest in its use (Strzelecki, 2023).

In addition, the concept of agency (Bandura, 2006), i.e. the ability to act autonomously and intentionally, is becoming increasingly central to AIED. This principle is fundamental to the interaction between students, teachers, and AI devices. Brod *et al.* (2023) have identified four levels of agency in the use of AI in educational contexts: full control by the student, shared control between student and device, full control by the teacher and shared control between teacher and device. The authors emphasise that advanced AI applications can dynamically adapt these levels of control and optimise the educational experience according to the individual characteristics of the user.

This approach of agency and interaction with AI systems opens new perspectives for the personalisation of education, allowing students to take an active role in their own education and teachers to modulate their intervention according to the specific educational needs and characteristics of their students. Although the use of AIED to support students with disabilities and special educational needs (SEN) is an emerging field whose potential is increasingly recognised, its application remains limited due to scarce academic research, the lack of specialised training programmes for professionals and the absence of specific regulations to protect vulnerable users. However, Smith *et al.* (2023) envisage the use of AI to develop customised assistive technologies for people with disabilities. Lampos *et al.* (2021) have also shown how AI could be used to develop effective supports for autistic students by analysing classroom interactions in real time to identify the most appropriate strategies for everyone, improving educational outcomes and ensuring personalised teaching. ML could also be used to recognise students at risk of dropping out of school and provide them with the support they need to continue their education.

Other studies emphasise the potential of AI in improving the learning of students with academic difficulties by creating tailored learning mediators. Reiss (2021) points out that AI can tailor educational provision to individual needs and support students with learning difficulties in activities such as reading, writing and maths. For example, AI can act as a writing assistant for people with dyslexia, helping them to correct common errors and adapt teaching materials to their needs by suggesting customised learning strategies (Zhai *et al.*, 2023). In addition, AI can enrich the learning experience of students from different cultural backgrounds by offering personalised learning paths and facilitating their inclusion in the class group (Salas-Pilco *et al.*, 2022).

4. Theoretical foundations of Learning Technologies Laboratories

The Learning Technologies Laboratories (LTL), offered as part of the Specialisation course for support activities[1] (CSA) at the University of Turin, aim to promote the development of an inclusive approach to teaching activities that integrate information and communication technologies (ICT). The main theoretical frame of reference is based on Universal Design for Learning (UDL; CAST, 2018; 2024), embedded in the conceptual framework of Inclusive education (Sanger, 2020). The LTL course is a 75-hour programme delivered over an academic year. It is developed in dialogue with the participants, alternating structured exposure phases with experimental moments, according to a collaborative and laboratory pedagogical perspective. The course includes the design, realisation, experimentation and exchange of multimedia projects tailored to the needs and characteristics of the professional contexts in which participants complete 150 hours of direct internship.

According to the UDL 2.2 Guidelines, the framework is anchored in three core principles aimed at fostering inclusive education. The first principle, Provide Multiple Means of Engagement, seeks to sustain learners' motivation through a variety of strategies tailored to stimulate attention and promote meaningful connections to the learning process. The second principle, Provide Multiple Means of Representation, focuses on delivering information in diverse and accessible formats to meet the diverse needs of learners and ensure comprehension. Finally, the third principle, Provide Multiple Means of Action & Expression, emphasises the provision of flexible opportunities for learners to demonstrate their understanding and skills, recognising the value of different methods of communication and assessment (Alba Pastor, 2019).

In line with the three foundational UDL principles, the LTL framework operationalises its approach through the development of 9 operational cues (Guastavigna, 2020): interactive images, web search devices, graphical representations of knowledge (Guastavigna, 2015), text comprehensibility (De Mauro, 1980; Piemontese, 1996), writing process, blogging and storytelling, use of videos, interactive activities and aggregation of content, digital books.

[1] The CSA is a teacher training program designed to prepare educators to effectively support students with disabilities, and ensure the implementation of inclusive educational practices. The training programme combines theoretical courses, practical labs, and an extensive internship. The last is divided into three components: direct internship, indirect internship, and a section dedicated to the use of ICT (totaling 300 hours).

These operational cues translate the theoretical framework of UDL into actionable strategies and make the principles of Engagement, Representation and Action & Expression tangible in real educational contexts.

For example, the use of interactive images exemplifies the principle of Representation by utilising iconic mediators as entry points for content exploration to ensure that students access information through visual supports that meet diverse learning preferences. Similarly, interactive activities and content aggregation enhance Engagement by structuring content in user-friendly ways that encourage exploration and interaction, while supporting Representation by organising materials in accessible formats. Each operational cue undergoes a systematic process that includes analysis, exemplification (based on meaningful experiences from previous editions of LTL), experimentation and critical reflection. The latter is carried out through collaborative dialogue with the participants in order to co-construct a shared foundation for the conscious and inclusive use of digital tools.

As part of their internships, participants must independently apply the knowledge acquired in the course tailoring it to the specific needs of their own school environment. With the support of the course instructor and the LTL working group, each participant progressively designs, refines and personalises inclusive multimedia projects to implement with their students during the internship. At the end of the programme, the participants present their work to the instructor and the group, explain the main results and subject them to a joint critical evaluation. This moment of sharing not only emphasises what has been achieved, but also promotes a reflective and collaborative approach to the continuous improvement of inclusive teaching practices.

5. GenAI integration in teacher training courses at the University of Turin

Any operative hint that respects the three basic principles of UDL can be implemented by teachers with the support of GenAI. As previously mentioned, the limited knowledge and skills of educators regarding the pedagogical use of AI devices remains a significant barrier to the effective integration of GenAI into classroom practise. To close this gap through targeted training initiatives, it is important to equip teachers with the skills they need to use AI in an inclusive and impactful way. To address the gaps in specific training on the use of AIED, the University of Turin offered four days of workshops in the summer of 2023 as part of the third edition of the "Expert in the Processes of Inclusive

Education" (EPIE) programme[2] (Damiani *et al.*, 2021). The workshop was attended by LTL teachers, CSA alumni and external specialists to reflect together on the use of GenAI in teacher training. The horizontal and dialogue-based collaboration during the workshop led to the formulation of 10 preliminary guidelines for a conscious and inclusive use of GenAI (Atzei *et al.*, 2023):

1. Do not limit yourself to ChatGPT: explore the wide range of AI applications available and their specific functions to best meet different educational needs.
2. Instructional design experts, not AI experts: the main goal is to be experts in instructional design, not artificial intelligence, to develop activities that align with educational goals.
3. Alignment of tasks assigned to AI with educational objectives: it is important that AI requirements align with educational objectives.
4. Review, refine and validate the results of the AI: the results generated by the AI must be carefully checked to correct errors, biases or misinterpretations.
5. Do not claim what you cannot critically evaluate: the AI results must be evaluated by an expert in the relevant field to ensure that the content is accurate and relevant.
6. Manage the entire process: deliberate use of AI requires selecting the most appropriate application, creating effective prompts, reviewing and revising the output in line with educational objectives.
7. Check the authority of the sources provided by AI carefully as they may not be reliable.
8. Do not use AI to assign meaningful tasks: AI should not be used to delegate meaningful tasks related to learning or professional development, such as the creation of concept maps.
9. Consider the dynamic nature of AI outputs over time: this needs to be considered when designing instructional activities, as AI outputs may change over time due to technical updates and continuous training of models.
10. Development of school policies: to ensure informed, accessible and emancipatory use of AIED, school policies need to be developed to govern the choice of devices, costs and licences for use.

In the 2023/2024 academic year, as part of the implementation of the 10 guidelines, experiments were carried out to integrate GenAI into the classroom, within the LTE framework of the CSA. We experimented with GenAI-based

[2] The EPIE course was designed and delivered by the Department of Philosophy and Education at the University of Turin to meet the increasing demand for qualified university teachers to support the growing number of students enrolled in Specialisation Courses for Support Activities (CSA).

applications to improve the comprehensibility of textbooks, with a particular focus on students with SEN. These tools were used to facilitate access to the knowledge conveyed in textbooks for those who could benefit from more accessible educational mediators. Among the software tested, we used applications specifically designed for linguistic simplification, such as Diffit for Teachers, as well as general LLM such as Google Gemini and ChatGPT. The results produced by these tools were compared with those obtained by traditional linguistic simplification techniques based on the protocols of De Mauro (1980) and Piemontese (1996), highlighting the strengths and limitations of both approaches. In addition, we explored the use of generic GenAI tools such as ChatGPT and Google Gemini to translate textbook content into narrative texts. The aim was to preserve the core knowledge conveyed in the textbooks while presenting it through engaging narratives. This transformation made it possible to supplement traditional textbooks with learning mediators that can encourage student motivation and accommodate alternative learning styles.

We also experimented with AI image creation tools, such as Adobe Firefly and DALL-E, to integrate simplified text and narratives with iconic mediators specifically designed to support learning. The generated images were created to be explanatory and provide additional visual aids to facilitate understanding of the content. In addition, some of these images were made interactive using specialised software such as Genially to create dynamic and interactive learning paths to further engage students and encourage not only understanding but also active participation. Finally, we tested AI software for the automatic creation of graphical representations of knowledge, such as Algor Education. The results generated by these tools were compared with those generated by the consistent application of principles from the literature, including the work of Novak and Gowin (1984), Buzan and Buzan (1993) and Guastavigna (2015).

6. GenAI as an Educational Assistant: Balancing Potential and Limitations in Human-Centered Teaching

Text manipulation activities, such as controlled writing and storytelling, have been shown to benefit significantly from the use of GenAI to create customised content tailored to students' needs. These materials, designed to convey knowledge in an accessible and engaging way, can be further enriched with explanatory images generated by AI applications such as Adobe Firefly or DALL-E. In addition, images created specifically for interactivity with tools such as Genially can enhance the clarity and immediate accessibility of interactive learning paths. The textual and visual content generated with GenAI can be seamlessly integrated into teaching strategies using aggregation platforms such as Padlet or learning management systems such as Moodle. These platforms allow teachers to present a coherent and dynamic learning pathway that combines multiple means of Engagement, Representation, Action and Expression, following the three pillars of UDL.

However, the design and development of educational mediators using GenAI required continuous and in-depth teacher intervention. The whole process, from the definition of the educational objectives to the gradual revision of the results provided by the tools, made it clear that a constant dialogue between educators and technology was required. This dialogue, which took the form of conversations between humans and machines, proved to be essential to ensure that the final products were in line with the psycho-pedagogical principles and the specific context of the classroom. Manual supervision was necessary to make the materials suitable for use by the students. Thanks to this constant interaction, the results achieved in improving text comprehensibility were generally satisfactory. The use of GenAI saved time on mechanical and repetitive tasks such as the creation of tables and basic diagrams, and allowed teachers to create drafts that could be progressively improved through requests for refinements and enhancements from the AI system, alongside manual corrections and integrations by the teacher.

However, there are still some challenges in creating graphical representations of knowledge. Experiments conducted with specialised applications such as Algor Education have shown that the results are only partially consistent with theoretical models established in the literature (Novak and Gowin, 1984; Buzan and Buzan, 1993; Guastavigna, 2015). In the experiments conducted at CSA, participants often found that the graphical representations produced by the AI lacked the depth, clarity and pedagogical effectiveness of those produced using traditional methods and academic principles.

The limitations of GenAI technologies manifested themselves in material inaccuracies, conceptual errors, faulty logical structures in solving complex problems, and simplified or distorted representations of complicated realities. Consequently, the experiments have shown that creating educational resources that are fully aligned with learning objectives often requires significant teacher intervention in the form of critical evaluation, revision and manual correction. This need detracts from the potential efficiency and effectiveness gains associated with these technologies. However, GenAI applications have proven to be particularly effective in automating the creation of preliminary content that is then refined and improved based on teacher input. In this way, educators can devote more time and energy to high-quality cognitive, creative and relational activities, such as lesson design, ensuring alignment with educational objectives and adapting materials to the specific context of their classrooms, potentially improving the overall quality of teaching and learning processes.

Over the last academic year, the integration of GenAI into education has revealed both significant potential and clear limitations. It has been shown that while GenAI applications can mimic the results of human cognitive functions, they cannot replicate the complexity of the underlying cognitive processes. This distinction, known as "Weak AI", highlights the difference between the functioning of GenAI, which is based on statistical and probabilistic algorithms, and the profound complexity of human thought. Consequently, GenAI should be seen as an assistant teaching tool rather than a replacement for human thinking.

For future applications, it is crucial to promote a deeper understanding and specific training for the pedagogical use of GenAI. The reflections made during the EPIE workshop and the experiments conducted at the CSA at the University of Turin have shown that in order to effectively integrate GenAI in the classroom, teachers must not only have a thorough understanding of its potential and limitations, but also rely on consolidated theoretical-methodological frameworks and strategies to consciously integrate it into teaching practise. This requires the development of tailored training programmes that provide teachers with the necessary skills to use GenAI as a pedagogical tool. In the creation of teaching materials, AI assistants can play a key role in personalising learning by adapting content to the individual needs of students to increase motivation and learning efficiency. However, developing complex educational content and adapting it appropriately to the teaching context requires careful human oversight to ensure that the materials are not only technically appropriate but also pedagogically oriented.

Looking to the future, and in line with recent updates to UNESCO (2024) and CAST (2024) guidelines, it is crucial to directly involve students in exploring AI-driven approaches to education, focusing on improving the conditions that support learning for all. This approach would further strengthen an inclusive, student-centred perspective focused on the real needs of the educational community.

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